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University of Rhode Island

1974-75 Graduate School Bulletin

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Volume LXX, Number 4, October 1974

Bulletin of the University of Rhode Island. Published quarterly by the University of Rhode Island, Kingston, Rhode Island 02881. Second-class postage paid at Wakefield, Rhode Island 02880.

The University

Green Hall

The University of Rhode Island, a land-grant institution founded in 1892, is located on 1200 acres in the village of Kingston, 30 miles south of Providence and six miles from the ocean. In 1971 it became one of the first four sea grant colleges in the United States. The faculty numbers over 850, and there are about 2500 graduate and 8200 undergraduate students enrolled. Approximately one-half of the graduate students are in full-time residence.

The University is made up of eight colleges and three schools: the Colleges of Arts and Sciences, Business Administration, Engineering, Home Economics, Nursing, Pharmacy, and Resource Development, the University College, the Graduate School, the Graduate Library School and the Graduate School of Oceanography.

The Division of University Extension in Providence enrolls about 5200 students in credit courses. The Master of Arts in English, the Master of Business Administration, and the Master of Public Administration degrees may be earned in the Division of University Extension as well as on the main campus.

The 2300-acre W. Alton Jones Campus, where research and conference facilities and a Youth Science Center are located, is 20 miles from Kingston in West Greenwich.

The Graduate School of Oceanography is located on the 165-acre Narragansett Bay Campus, six miles from Kingston on the west shore of Narragansett Bay within easy reach of both bay and open ocean. Major buildings include the Charles J. Fish Laboratory, the Claiborne Pell Marine Science Library, the Francis H. Horn Research Laboratory, a research aquarium, and a number of smaller laboratory and research facilities. The campus also includes the state of Rhode Island's nuclear reactor

and federal laboratories devoted to the marine sciences. A marine experiment station is located on the saltmarsh at Jerusalem, Rhode Island.

The University of Rhode Island is an equal opportunity/affirmative action institution.

ACCREDITATION

The accrediting agencies which have approved the quality of the course offerings of the University of Rhode Island include the American Association of Universities, the American Association of Collegiate Schools of Business, the American Chemical Society, the American Council on Pharmaceutical Education, the American Library Association, the Engineers Council for Professional Development, the National League for Nursing, the New England Association of Colleges and Secondary Schools, and the State University of New York.

The University is also an approved member institution of the American Association of University Women, the Council of Graduate Schools in the United States, the National Association of Schools of Music, the National Association of Summer Sessions, and the National University Extension Association. The Doctor of Philosophy program in clinical psychology is provisionally accredited by the American Psychological Association.

GRADUATE STUDY

The Dean of the Graduate School has primary responsibility for administering the policies and procedures relating to advanced study at the University of Rhode Island. Graduate School policy is made by the Graduate Faculty, acting through its delegate body, the Graduate Council which includes student members. Only the Dean or the Graduate Council may grant exceptions to the regulations for graduate study, which are explained in detail in the *Graduate School Manual.*

Graduate study at the University was inaugurated in 1907 with the Master of Science degrees in chemistry and in engineering. The Master of Arts degree was first awarded in 1951 and in 1960 the University awarded its first Doctor of Philosophy degree. Graduate work for professional degrees was initiated in 1962 when the degree of Master of Public Administration was first awarded. Today, the master's degree is offered in over 65 areas of study and the doctorate in 24 areas.

GRADUATE DEGREE PROGRAMS

The University offers the programs of study listed below. Work in a combination of special areas is usually possible.

MASTER OF ARTS

Economics
Education
- Educational Research
- Elementary Education
- Guidance and Counseling
- Reading Education
- Science Education
- Secondary Education
- Youth and Adult Education

English
French
Geography
History
Philosophy
Political Science
- International Relations

Sociology
Spanish
Speech Pathology and Audiology

MASTER OF SCIENCE

Accounting
Animal Pathology
Animal Science
Biochemistry

Biophysics
Botany
Business Education
Chemical Engineering
Chemistry
Child Development and Family Relations
Civil and Environmental Engineering
Computer Science
Electrical Engineering
Environmental Biology
Environmental Health Sciences
Experimental Statistics
Food and Nutritional Science
Food and Resource Chemistry
Geology
Home Economics Education
Industrial Engineering
Mathematics
Mechanical Engineering and Applied Mechanics
Medicinal Chemistry
Microbiology
Nuclear Engineering
Nursing
Ocean Engineering
Oceanography
Pharmacognosy
Pharmacology and Toxicology
Pharmacy
Pharmacy Administration
Physical Education (men and women)
Physics
Plant and Soil Science
Plant Pathology-Entomology
Psychology (school)
Resource Economics
Speech Pathology and Audiology
Textiles, Clothing and Related Art
Zoology

DOCTOR OF PHILOSOPHY

Biological Sciences
- Animal Pathology
- Biochemistry
- Biophysics
- Botany
- Food and Resource Chemistry
- Microbiology
- Plant Pathology-Entomology
- Zoology

Chemical Engineering
Chemistry
Civil and Environmental Engineering
Electrical Engineering
- Biomedical Engineering

English
Mathematics
Mechanical Engineering and Applied Mechanics
Ocean Engineering
Oceanography
Pharmaceutical Sciences
- Medicinal Chemistry
- Pharmacognosy
- Pharmacology and Toxicology
- Pharmacy

Physics
Psychology

PROFESSIONAL DEGREES

Master of Business Administration (M.B.A.)
Master of Community Planning (M.C.P.)
Master of Library Science (M.L.S.)
Master of Marine Affairs (M.M.A.)
Master of Public Administration (M.P.A.)

RESEARCH

Active research programs are carried on throughout the University and are supported by foundations, commercial firms, the United States government and the University. Specialized research is carried on in the several areas described below.

The Coordinator of Research signs, on behalf of the University, applications for research grants, maintains files of funding agencies, keeps a current facilities inventory, and in general acts as a liaison officer for the President, the business manager, the academic deans, the Research Committee and the faculty in matters pertaining to the general research policy.

AGRICULTURAL EXPERIMENT STATION

The station, within the College of Resource Development, was established in 1888 and is concerned with basic and applied investigation in natural and human resources. This research aims to conserve and manage resources, improve the quality of environments, abate pollution and recycle waste materials, enhance rural environments, develop more rewarding home life, and support resource-using industry and business in the region. Research is conducted in food and resource chemistry, resource economics, plant and soil science, plant pathology-entomology, forest and wildlife management, animal science, and animal pathology. A strong orientation to estuarine and marine problems, and an interdisciplinary approach to resource research are station characteristics.

BUREAU OF GOVERNMENT RESEARCH

The bureau was organized in 1960 to provide service to municipalities and to the state. The bureau maintains a municipal consulting service which assists Rhode Island communities in dealing with problems of governmental organization and administration. It has a publications program including a research series, an information series, and a monthly newsletter, and operates a program of conferences and awards. The bureau assists in the administration of the graduate program in public administration, and maintains a public administration library and an information service for local government units.

DIVISION OF ENGINEERING RESEARCH AND DEVELOPMENT

The division was established in 1942 to coordinate the research activities of the College of Engineering. It disseminates the results of basic or fundamental investigations; conducts fundamental and applied research projects; provides opportunities for graduate students and highly qualified undergraduates to participate in research studies; and offers opportunities for members of the engineering faculty, through research, to keep abreast of advances in the profession. Facilities are available for research in the fields of chemical, civil, electrical, industrial, mechanical, materials, nuclear, environmental and ocean engineering.

INSTITUTE OF ENVIRONMENTAL BIOLOGY

The institute is an administrative organization consisting of faculty members active in graduate training and research in botany, electrical engineering, forestry, oceanography, pharmacology, and zoology, and of adjunct faculty members in associated federal and private laboratories, who provide an interdisciplinary approach to problems in environmental biology.

LABORATORIES FOR SCIENTIFIC CRIMINAL INVESTIGATION

These laboratories in the Department of Pharmacology and Toxicology of the College of Pharmacy provide instruction, research, and service in the field of scientific criminal investigation. The laboratory staff works closely with the Rhode Island Attorney General's Office and also provides technical consultation for various law enforcement agencies, and special instruction and research in criminalistics, in which faculty members of various departments participate. The program sponsors a special course for police and law enforcement agencies.

MARINE RESEARCH PROGRAMS

A number of marine research programs are carried on at the University and are coordinated under the Provost for Marine Affairs. These include basic and applied research in the several areas of physical, chemical, geological and biological oceanography within the Graduate School of Oceanography; as well as areas within the Colleges of Arts and Sciences, Engineering, Pharmacy and Resource Development.

The *Sea Grant College Program,* started in 1968 with funds from the Sea Grant College and Program Act of 1968, encompasses specialized marine research, education and public service projects in many departments of the University. Both the URI *Marine Advisory Service,* which provides marine extension services in the state, and the *New England Marine Resources Information Program,* which does the same in New England, are based at the University and are part of the Sea Grant Program.

With initial support from the Agency for International Development, the University in 1969 created the *International Center for Marine Resource Development* to assist developing countries in using food and other resources from the sea.

The *Law of the Sea Institute,* established in 1965,

conducts summer conferences designed to elucidate legal and jurisdictional problems in ocean resource exploitation. It is administered through the University and directed by a board composed of specialists drawn from various parts of the country.

The *Coastal Resources Center,* established in 1971 to assist the Rhode Island Coastal Resources Management Council in preparation of coastal and marine management plans for the state and its political subdivisions, is based at the University.

RESEARCH CENTER IN BUSINESS AND ECONOMICS

The center, established in 1965, coordinates the research activities of the College of Business Administration. The center initiates, conducts, and services research activities of the faculty in the fields of accounting, business education and office administration, business law, economics, finance, insurance, management science, marketing management, organizational management and industrial relations, and production and operations management.

RHODE ISLAND WATER RESOURCES CENTER

This is the state center for research and training in all phases of water resources. Similar centers in each of the 50 states and Guam, Puerto Rico and the Virgin Islands were established by law in 1964 and work cooperatively with the federal government in an effort "to assist in assuring the nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population." Principal investigators of projects need not be employed at the University.

THE UNIVERSITY LIBRARIES

The University's library collection of over 510,000 volumes is housed in the University Library and its Rodman Hall annex, the Pastore Hall Chemistry Library, the Division of University Extension Library in Providence, and the Claiborne Pell Marine Science Library on the Narragansett Bay Campus.

The University Library, which holds the bulk of the collection, is a four-story, air-conditioned building where open stacks provide direct access to books, periodicals, documents, maps, microforms and audiovisual materials. The Special Collections Department collects and maintains rare books, manuscripts, the University archives and a variety of special interest materials. Service hours at the other libraries vary, but the University Library provides full reference, bibliographic and circulation services during most of the 90 hours per week it is open. Coin operated copiers are available for reproducing pages from books and journals, and for producing copy from microform. A computer-based bibliographic system makes most books available to users one week after their receipt.

The Pell Library contains a wide collection of books and periodicals on the marine sciences and reports of major oceanographic expeditions, making it one of the most complete marine science libraries on the east coast. It has been designated the National Sea Grant Depository. The building also houses a remote computer console linked with the Computer Laboratory.

RESEARCH RESOURCES

The Computer Laboratory has an IBM system/370 model 155 with 1536K of high speed storage, disk storage units, magnetic tape, card, and printer input/output devices, and an off-line plotter. The system's hardware and software accommodate both remote batch and interactive terminal usage as well as normal batch processing. Intermediate-speed remote batch terminals are installed within the Graduate School of Oceanography and the Department of Civil and Environmental Engineering. The Department of Electrical Engineering has two PDP-9 computers with a graphics display console linked to the Computer Laboratory's system. A Nova 1200 computer with a 16 channel A to D converter and Versatec printer-plotter located in the Department of Ocean Engineering has a magnetic tape input/output system compatible with the 370 system. The staff members of the Department of Computer Science and Experimental Statistics provide consultation in numerical methods, statistical analysis and computational techniques.

Computer graphics facilities, graphical input and output devices, are also located in the electrical engineering building. The chemical engineering building has an applied dynamics 32 PB analog computer, ultra-high pressure and high-pressure temperature equipment that permits study of solid state under pressures of up to 80 kilobars and temperatures up to 2000°C, and a nuclear laboratory including counting equipment, multi-channel analyzers, and subcritical assembly.

Other equipment includes an off-line incremental plotter, a major laboratory for research on photo-electronic imaging devices, optical properties of materials and micro-electronics, electro-magnetically shielded rooms for biomedical research, a field station for radio-propagation research, pressure chambers for leak testing equipment prior to deep-sea use, triaxial test chambers for soil and sediment testing, a newly-designed rotating basin for

Graduate student apartment

studying basic problems in oceanographic hydrodynamics, reverberant and anechoic rooms for airborne acoustics work, X-ray radiographs and spectographs, electron microscopes and scanning electron microscopes, a low-speed wind tunnel located in the mechanical engineering building for fluid mechanics studies, a large buoy to monitor Narragansett Bay pollution parameters and telemeter data to the Nova 1200 computer, an underwater acoustics test facility, Deep Ocean Sediment Probe (DOSP) for in-situ sediment measurements, a marine experimental aquarium located on Narragansett Bay Campus, and a mass spectrometer.

The University's research vessel, *Trident,* operated by the Graduate School of Oceanography, is a 180-foot ship capable of working in all parts of the world's oceans. It can carry a scientific party of 13 men and women, can work continuously at sea for 60 days and provides one of the largest laboratory areas of any United States research vessel. Two 45-foot motor cruisers, *Gail Ann* and *Crowsnest VI,* are part of the permanent fleet and a 40-foot dragger. *Billie II,* is chartered on a year-round basis for work in Narragansett Bay and Rhode Island Sound.

Students at the University have a research reactor and associated facilities available to them at the Rhode Island Nuclear Science Center, located on the Narragansett Bay Campus. Constructed and operated by the state of Rhode Island, this critical reactor is extensively used for research by many departments of the University. The reactor, designed for 5MW, is now operating at 2MW. A subcritical reactor is located on the main campus.

UNIVERSITY OMBUDSMAN

The ombudsman investigates complaints from students, faculty and administrative personnel that they have been unfairly dealt with in the normal channels of administrative process. An opportunity is thus provided for a personal appeal to an impartial official with broad perspective who has ready access to all levels to those involved in a grievance. The ombudsman is always available to receive complaints, inquire into the matters involved and mediate or otherwise resolve the problem. He does not, however, concern himself with the normal operations of established procedures as outlined in the *Graduate Student Manual* except where it appears to him that they are not functioning as intended.

The ombudsman, Wayne K. Durfee, and his student assistant have an office in the Memorial Union.

GRADUATE LIFE

Students find unique advantages at a University located in a small village in the heart of the northeastern Megalopolis. Cultural variety and compact size are combined in the state of Rhode Island, and other cultural centers are easily accessible. Boston is 80 miles to the north and New York City 160 miles southwest. Direct bus service to these cities, as well as to Providence, Newport and Cape Cod, is available from the campus. The Kingston station of the Penn Central Railroad is two miles away.

SERVICES

The recreational and cultural facilities of the campus are open to graduate students, including use of the Memorial Union building. Facilities there include meeting rooms, lounges, bowling lanes, billiards, table tennis, the University Bookstore, cafeteria, and snack bar. Services include an information center, barber shop, bank, travel agency, laundry pickup station, Western Union office, record and art print libraries, and student pub serving wine and beer.

Every effort is made to provide graduate students with opportunities for consultation and advice on matters of concern to them in their academic, ex-

tracurricular and personal lives. Descriptions of available services and facilities, including those associated with religious life, may be found in the *Undergraduate Catalog*. Of particular interest to graduate students are the following: Career Planning and Placement, 80 Lower College Road; Counseling Center, Roosevelt Hall; Health Service, Potter Building; Housing Office, Roger Williams Complex; International Student Affairs, Taft Hall; Religious Counselors, Memorial Union and Catholic Center; Student Aid Office, Davis Hall.

SERVICES FOR THE DISADVANTAGED OR HANDICAPPED

The Dean of the Graduate School, the Director of Career Planning and Placement, the Director of Counseling, and the Director of the (undergraduate) Special Program for Talent Development cooperate to provide information and guidance for economically and socially disadvantaged individuals seeking opportunities for graduate study at the University. Inquiries may be directed to any of these offices.

Special counseling for physically, psychologically, or vocationally handicapped individuals is available from the Counseling Center.

GRADUATE STUDENT ASSOCIATION

This organization is interested in both the academic and social aspects of graduate life. Officers and representatives of the association are elected annually from the entire graduate student body and the association is represented on the Graduate Council. The association publishes a newspaper, *The Grad Side*.

There are also organizations for wives of graduate students and for students from foreign countries.

LIVING ACCOMMODATIONS

A new housing complex and several older buildings provide 140 units of unfurnished apartments for graduate students. There is usually a waiting list for these and interested students should write to the University Housing Office for additional information and applications. The Housing Office also maintains a list of off-campus rooms, apartments, and houses which may be rented by graduate students. For these the use of a car is desirable. For further information on housing, including current costs, interested students should contact the Director of Housing, Roger Williams Complex.

Dining services are available for graduate students and their guests at any of the University dining halls. The Ram's Den in the Memorial Union provides additional services. Students desiring University board must sign a semester contract based on a 15-meal week (three meals per day, Monday through Friday). Current costs and other specific information may be obtained from the Director of Dining Services, Lippitt Hall.

ARMY ROTC

A new two-year program has been designed to fill the needs of graduate students who have not taken Army ROTC during their undergraduate years. The United States Army offers the opportunity to earn commissions as second lieutenants after two years of on-campus ROTC training. The student attends a six-week basic summer camp after graduation with the bachelor's degree and completes the advanced ROTC course while attending graduate school.

ACADEMIC AND SOCIAL CODES

Each student is a member of the University community with all the rights, privileges and responsibilities that go with such membership. The rights and privileges include full use of the educational opportunities and facilities offered on the campus. The responsibilities include those of making proper use of these facilities in order to progress educationally, of respecting the rights of others, and of knowing and obeying the rules and regulations developed by the University community for the good of the total membership.

The University expects that all course papers, theses and dissertations will be prepared and all examinations taken in conformance with accepted standards of academic integrity. This includes the proper citation and attribution of all material which is not the original product of the writer. It is the graduate student's responsibility to determine the appropriate style used in his or her discipline for presentation of material derived from other sources and to adhere to it scrupulously in all written presentations. Where no special disciplinary style exists, that given in Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations*, published by the University of Chicago Press, should be used.

NOTICE OF CHANGE

Rules, regulations, dates, charges, and fees set forth in this catalog are subject to change without notice.

Pharmacognosy greenhouse

Degree Requirements

Each advanced degree awarded by the University requires as a minimum the successful completion of a specified number of approved credits of graduate study at the University and the passing of prescribed examinations. Credit hours for a master's or doctoral degree may include formal course work, independent study, research, preparation of a thesis or dissertation, and such other scholarly activities as are approved by the candidate's program committee and the Dean of the Graduate School.

It is the student's responsibility to know the calendar, regulations and pertinent procedures of the Graduate School and to meet its standards and requirements. These are set forth in this bulletin, the *Graduate Student Manual,* the *Statement on Thesis Preparation,* and other publications, all of which are available to graduate students at the Graduate School Office.

These documents govern both master's and doctoral degree programs. The manual gives detailed information on preparation of theses and dissertations, examination procedures, and responsibilities of major professors and program committees.

The requirements immediately following are *general requirements* for all graduate students. *Specific requirements* for individual programs are itemized in the section on Graduate Programs.

PROGRAM OF STUDIES

All degree candidates are required to prepare a program of studies with the guidance of their major professors (for master's degree programs) or of their program committees (for doctoral programs) in accordance with the guidelines in the *Graduate Student Manual.* After the program has been approved by the major professor for master's degree candidates or program committee for doctoral candidates as specified in the manual, the program of studies is to be submitted for approval to the Dean of the Graduate School.

The purpose of the program of studies is to ensure that the student, at an early stage in his graduate study, organizes a coherent, individualized plan for his course work and research activities. It is expected that the successful completion of the student's program of studies along with collateral readings, research, etc., will enable him to demonstrate that he has achieved the high level of competence required of graduate students in their respective fields.

COURSE NUMBERING SYSTEM

All graduate courses are now numbered at the 500, 600, and 900 levels (though not all 900-level courses carry graduate credit). Courses numbered at the 400 level are for advanced undergraduates, but may, with approval and to a limited extent, be accepted toward meeting degree requirements at the master's level. For doctoral candidates who have completed the master's degree in the same field or one closely related, all program work must be at the 500- or 600-level. Candidates for the doctorate may receive up to 30 credits toward the minimum required for recent graduate work taken at other institutions if appropriate for the program and discipline.

SCHOLASTIC STANDING

Graduate work is evaluated by letter grades. All grades earned, however, will remain on the student's record and, unless the courses were approved

for no program credit prior to registration, will be included in calculating the student's scholastic average. Only grades of A and B carry graduate credit for courses below the 500 level. In 500-, 600-, and 900-level graduate courses only grades of A, B and C will be credited toward the degree.

A grade of C or lower in courses numbered below the 500 level is considered a failing grade. In such cases of failure the course must either be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School. If a student receives mores than one C in courses below the 500 level, his graduate status is subject to review by the Dean of the Graduate School.

Grades of D and F are failing grades in 500-, 600-, and 900-level courses and require immediate review of the student's status. Courses failed at this level must be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School.

The grades S (satisfactory) and U (unsatisfactory) will be used for courses of study involving research undertaken for the thesis or dissertation and for certain courses and seminars so designated. The letter I (incomplete) is used for excused unfinished work. Incomplete grades assigned to graduate students in May 1971 or thereafter may be removed within one calendar year by completion of the required work. If the grade of I (incomplete) is not removed within one calendar year, it will remain on the transcript but may not be used for program credit. Grades of S, U, and I are not included in the academic average.

For graduation an average of B (3.0 on a 4.0 scale) in all work is required, except for courses meeting entrance deficiencies or approved for no program credit prior to registration in the course. At any time when the student's record indicates unsatisfactory performance his status is subject to review. A student who fails to maintain satisfactory scholarship or to make acceptable progress in his program will be terminated as a graduate student.

MASTER'S DEGREE REQUIREMENTS

There are no major or minor area requirements for the master's degree. However, no degree can be awarded for the accumulation of credits without a planned program of study. Courses for the degree are expected to be concentrated in the candidate's field of interest and related areas to produce a well-developed and coherent program which will meet his special objectives.

Requirements for the master's degree must be completed within a period of five calendar years, or seven calendar years with special permission of the department and the Dean of the Graduate School if the study is done on a part-time basis. The master's degree may be earned either through full- or part-time study or by a combination of the two. Candidates must take at least 80 percent of the credits required for the degree at the University of Rhode Island.

Some departments offer both a thesis and a non-thesis option while others offer only one plan. Please refer to the chapter on Graduate Programs for specific information on each program. The general requirements for these options are as follows.

THESIS OPTION

The minimum requirements for a master's degree are: (1) The successful completion of 30 credits, including 6 thesis research credits. (2) At the discretion of the department, the passing of written comprehensive examinations toward the end of the course work. (3) The submission of an acceptable thesis and the passing of an oral examination in defense of the thesis. Four copies of the thesis prepared in accordance with Graduate School requirements must be submitted to the Graduate School Office. A statement on preparation of theses is available from that office.

NON-THESIS OPTION

Depending upon departmental requirements, some master's degrees may be earned without a thesis. The minimum requirements for a non-thesis master's degree program are: (1) The successful completion of a minimum of 30 credits. (2) Registration in advanced seminars, practicums, internships, or other experiences useful to the student's future professional career. (3) Registration in one course which requires a substantial paper involving significant independent study. (4) The passing of a written comprehensive examination toward the end of the course work. Some departments may also require a final oral examination.

LANGUAGE

Although the Graduate School does not stipulate a language requirement for the master's degree, certain academic departments require proficiency in a foreign language.

PROFESSIONAL DEGREE REQUIREMENTS

Students should refer to the specific program requirements for professional degrees and consult with the appropriate dean or director.

DOCTOR OF PHILOSOPHY DEGREE REQUIREMENTS

The Doctor of Philosophy degree must be completed within seven years of the date when the student is first enrolled as a candidate.

The requirements for the doctor's degree are: (1) The completion of a minimum of 72 credit hours of graduate study beyond the baccalaureate degree, of which a minimum of 42 credit hours must be taken at the University of Rhode Island. (2) Satisfying the residence requirement that the student must maintain full-time residence for at least two semesters, exclusive of summer sessions, while ac-

quiring the last 42 credits for the degree. Residence is interpreted as full-time attendance on campus or in the Division of University Extension during a regularly scheduled semester. Study carried on elsewhere under a University adjunct professor or in a laboratory having University of Rhode Island affiliation may also qualify as residence. With the exception of faculty, graduate assistants, research assistants, and other employees of the University, no candidate for the doctorate may count, except by action of the Graduate Council, part-time study toward satisfying this residence requirement. (3) If required by his department, proficiency in one or more foreign languages and/or in an approved research tool. (4) The passing of a qualifying examination. (5) The passing of a comprehensive examination. (6) The completion of a satisfactory dissertation. (7) The passing of a final oral examination in defense of the dissertation. The department in which the student studies for the doctor's degree may or may not require a master's degree preliminary to, or as a part of, the regular course of study.

Qualifying Examination

This examination is intended to assess a student's potential to perform satisfactorily at the doctoral level, and is not a review of courses taken. A student without a master's degree who is accepted as a doctoral candidate is expected to take a qualifying examination, usually after 24-30 credits of coursework have been completed. A student who holds a master's degree in the same or a closely related field is normally not required to take the examination. If an examination is to be required, it will be stipulated in the letter of admission.

Comprehensive Examination

Each doctoral candidate shall take comprehensive examinations at or near, but not later than 12 months after, completion of the formal courses stipulated in the program of study. The examination is designed to assess the student's intellectual capacity and adequacy of training for scholarly research.

The comprehensive examination consists of two parts: written, requiring a minimum of eight hours; and oral, requiring not more than two hours. The student, with the approval of his program committee, applies to the Graduate School to take the examination. The oral examination committee includes the student's committee and two additional members of the Graduate Faculty appointed by the Dean of the Graduate School. One of the additional members represents a field of study allied to that of the student's concentration. The candidate's major professor arranges for and chairs the examination. Unanimous approval by the examining committee is required for passing the comprehensive examination.

A candidate whose performance fails to receive unanimous approval of either examining committee may, upon the committee's recommendation, be permitted one reexamination in the part or parts failed, to be taken only after an interval of at least ten weeks.

Final Oral Examination

This examination is a defense of the dissertation and is open to all members of the faculty and, generally, to all students. The examination, usually two hours long, is conducted by an examining committee comprised of the candidate's program committee and two additional graduate faculty members appointed by the Dean of the Graduate School. One of the appointed members will be designated by the Dean to chair the examination.

Unanimous approval of the examining committee is required for passing. If the candidate does not perform satisfactorily, the committee may recommend one reexamination under stated conditions.

Research Tool

Each department, in cooperation with the Graduate School, is authorized to formulate and to amend its own requirements and methods of testing for competency in research tools (such as computer science, foreign language(s) or statistics). The department may, in turn, delegate this responsibility to the program committee for each individual doctoral candidate.

THESES AND DISSERTATIONS

For the oral defense, a sufficient number of completed copies of the thesis or dissertation, in a form acceptable to each member of the examining committee and the Dean of the Graduate School, is required. After all changes and corrections have been made, four copies prepared in accordance with Graduate School and Library requirements must be submitted to the Graduate School Office. Four copies of an abstract, not to exceed 600 words, are also required.

Students are advised to consult the *Statement on Thesis Preparation and Instructions for Thesis Defense* available in the Graduate School Office and the most recent edition of Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations* published by the University of Chicago Press.

Admission and Registration

ADMISSION

Persons holding the baccalaureate degree and wishing to take graduate-level courses at the University may do so through admission to the Graduate School as degree candidates or may be accepted for postbaccalaureate work as non-degree students. Admission to the Graduate School is based upon academic qualifications and potential without regard to age, race, religion, sex or national origin.

Application forms may be obtained from the Dean of the Graduate School, University of Rhode Island, Kingston, Rhode Island 02881. Zip code should be included in the applicant's return address. Inquiries concerning particular degree programs or courses of instruction should be addressed to the appropriate department chairman.

Applications and credentials are to be submitted to the Dean of the Graduate School who, after obtaining the recommendation of the department concerned, notifies the applicant of either full or conditional admission, or rejection. Final decision rests with the Dean of the Graduate School.

All applications must be accompanied by a $12 non-refundable application fee. Simultaneous application to more than one department requires duplicate applications and credentials and separate application fees.

General deadlines for receipt of applications and all supporting documents are April 15 for September or Summer Session admission, and November 15 for February admission. As is indicated in the Graduate Programs section of this bulletin, certain programs admit students only for September and/or have earlier deadlines. There is no assurance that applications received after these dates will be processed in time for enrollment in the desired semester.

Foreign Applicants

Applicants from foreign countries must complete the Test of English as a Foreign Language (TOEFL) with minimum scores of 500 for science students and 550 for non-science students. All inquiries from foreign students concerning applications, fees, housing, etc., should be sent to the Director for International Student Affairs, Taft Hall.

Transfer Credit

Transfer credit may be requested for graduate work taken at other accredited institutions of higher learning. Such credits may not exceed 20 percent of the total credits required for the master's degree program or 30 credits in a doctoral program. The transfer work must have been taken at the graduate level (equivalent to the 500 level or higher in the University of Rhode Island course numbering system) and graded as B or higher, must have been completed not more than five years prior to the date of request for transfer into a master's program (ten years for the doctoral program), and must have a clear and unquestioned relevance to the student's program of study. The request for transfer credit must have the approval of the student's major professor and the Dean of the Graduate School. If transfer credit is desired for work taken elsewhere after a graduate student is enrolled at this University, *prior* approval must be obtained from the Dean of the Graduate School.

Degree Candidates

Applicants must forward to the Dean of the Graduate School two completed application forms, two official copies of transcripts of all previous college work sent directly by the issuing institutions,

three letters of recommendation and scores in the appropriate nationally administered tests. Tests required for specific programs may be found in the Graduate Programs section of this bulletin.

For acceptance on full status in the Graduate School, in addition to satisfactory test scores and references, applicants should have maintained an undergraduate average of approximately B (3.0 on a 4.0 scale). Applicants with undergraduate averages below this level, but not less than 2.0, may be admitted to conditional status upon the submission of high test scores. Such persons will be admitted to full graduate standing upon the completion of the equivalent of one semester of full-time work with a grade average of B or better. No student may remain on conditional status for more than two consecutive semesters.

In certain cases, applicants who have been denied admission may be advised to take several courses in non-degree status (see below) to provide a basis for a later reconsideration of their applications. In such cases, these courses are usually regarded as entrance deficiencies and are not accepted for advanced standing within minimum-credit programs of study.

NON-DEGREE STUDENTS

Non-degree students are those who desire registration with credits in courses during a regular academic year and who are not seeking an advanced degree. Non-degree students do not have the privileges regularly enjoyed by degree candidates. For example, their enrollment in courses is subject to the accommodation of degree candidates wishing to take those courses. No more than a total of 12 credit hours of work taken at the University of Rhode Island in non-degree status may be applied toward degree requirements if the student is later admitted to a degree program, and then only upon recommendation of the student's program committee and with the approval of the Dean of the Graduate School. Advanced standing for work taken at another institution, or obtained by examination or equivalency, must also be included within this limit.

Applicants seeking acceptance in non-degree status must file the regular application for admission and submit the required transcripts. They need not, however, submit letters of recommendation or scores on nationally administered tests until such time as they may wish to apply for admission to a degree program.

REGISTRATION

The responsibility for being properly registered rests with the student. Each student must register and complete his registration within the time period announced by the University. The chairman of the student's major department will assign an adviser to assist the new graduate student in planning his program.

Registration for each semester consists of three separate procedures: registering for course selections, payment of fees, and obtaining a class program.

REGISTERING FOR COURSE SELECTIONS

Students must obtain registration materials at the announced time and place. Currently enrolled students register in November for the spring semester and in April for the fall semester. Completed registration materials are submitted to the Registrar during the registration period, according to the announced instructions.

New and transfer students will be instructed concerning registration procedures.

PAYMENT OF FEES

Arrangements must be made with the Bursar for complete payment of tuition and/or fees by the due date. Class programs will be issued only for those students who have registered for course selections, and satisfied payment requirements with the Bursar.

CLASS PROGRAMS

Students may not attend classes without class programs. These are issued prior to the first day of classes according to instructions from the Office of the Registrar.

DROP AND ADD

Students are permitted to drop courses without a fee penalty (see page 18) during the first two weeks of classes and may add courses for two additional class days beyond these two weeks. The final day to drop courses without a failing grade is midsemester.

CHANGE OF ADDRESS

It is the responsibility of the student to complete a change of address form in the Office of the Registrar whenever a change is made in his local, campus, or mailing address.

SUMMER SESSION

Although many graduate-level courses are offered during the Summer Session, the University does not guarantee that any particular course will be offered. The availability of individual faculty members to supervise research or to participate in comprehensive

examinations and examinations in defense of theses or dissertations during the Summer Session varies from year to year. During the Summer Session, special arrangements must be made with both the Graduate School and the department for scheduling comprehensive examinations and thesis or dissertation defenses. Graduate students must make prior, individual arrangements for taking directed studies or special problems courses, which require approval of the Dean of the Graduate School and the Dean of the Summer Session.

TIME LIMIT AND CONTINUOUS REGISTRATION

A graduate student is expected to complete his course work and research within the five-year time limit prescribed for the master's degree and the seven-year time limit for the doctorate. A student who has completed his course work and residence requirement is required to register and pay for Continuous Registration (CR) until his thesis or dissertation and all examination requirements are completed. A student must also be registered for either course work or CR during the semester in which he expects to complete all degree requirements. Upon application to the Dean of the Graduate School, the time limit for a degree program may be extended for such legitimate reasons as military service or serious illness. This request requires the endorsement of the student's major professor or department chairman.

See the *Graduate Student Manual 1974*, Section IV.B., for regulations regarding interruptions of study, notification requirements, and circumstances under which graduate students will be assumed to have withdrawn from the University.

FULL-TIME AND PART-TIME STUDENTS

The normal full-time registration is 12 credit hours of study during a regular semester. Minimum full-time registration is nine credit hours during a regular semester and six credit hours during a summer term. Full-time registration is required of all students holding fellowships, scholarships, and traineeships administered by the University. Students who do not meet the minimum full-time registration requirement are considered part-time students.

OFF-CAMPUS ACTIVITY

Students who wish to register for credits to be counted toward a degree, and who will be earning these credits through off-campus activities such as research or independent study at a national laboratory, are required to obtain prior approval of the Dean of the Graduate School and to have these activities listed as part of their programs of study.

INTELLECTUAL OPPORTUNITY PLAN (PASS/FAIL OPTION)

To allow graduate students to venture into new areas of knowledge without fear that their scholastic average will suffer, the Graduate Council has approved the Intellectual Opportunity Plan. To be eligible for this option, the student's major professor or adviser must certify that the course or courses are outside the student's major field of study, are not entrance deficiencies, and are not specific requirements of, but are relevant to, the student's program. A maximum of four credit hours may be taken by the master's degree candidate and a maximum of eight credit hours, including any taken as a master's candidate, by the Ph.D. candidate.

CREDIT BY EXAMINATION OR EQUIVALENT

In master's programs only, a maximum of six credits may be allowed for competency based on experience outside the traditional academic setting and demonstrated by examination or equivalent. This maximum of six credits must fit within an overall maximum of 12 credits including program credit allowed for advanced standing and transfer credit, if any. See the *Graduate Student Manual 1974*, Section IV.G., for details of this procedure.

AUDIT

Courses may be audited with the approval of individual course instructors and by presenting an auditor's card secured from the Registrar. An auditor receives no course grade; consequently, an audited course does not count as part of the student's course load for registration purposes, and cannot count as work taken toward completion of residence requirements.

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Fees and Financial Aid

Charges and fees set forth in this bulletin are subject to change without notice.

Tuition and fees vary according to whether or not the student is a legal resident of the state of Rhode Island and according to full-time or part-time enrollment. All charges are payable by the semester on receipt of the bill.

The Dean of the Graduate School classifies each student admitted to the University as a resident or nonresident student on the basis of all relevant information available to him. A Rhode Island resident must file with the Bursar a certificate of residence signed by the clerk of the Rhode Island city or town where he claims legal residence. A student may appeal the decision to the Board of Residence Review.

New England Regional Student Program

Under the provisions of the New England Regional Student Program for graduate students, administered by the New England Board of Higher Education, the University charges the Rhode Island resident tuition rate to residents of another New England state who are matriculated graduate students in certain programs. The specific program must be one which is *not available* at the student's home-state university. To take advantage of this program, a resident of another New England state must obtain certification from the Dean of the Graduate School of his home-state university that the program of study is not available there. Applicants should, therefore, examine the pertinent catalogs and course offerings carefully. In cases where an apparently similar program of study is available at both institutions involved, the certification will normally take the form of an endorsement by the Graduate Dean of a statement from the chairman of the relevant department of study. Inquiries and requests for further information may be directed to the Dean of the Graduate School at the University of Rhode Island or to the New England Board of Higher Education, 40 Grove Street, Wellesley, Massachusetts 02181.

Schedule of Fees

This schedule of fees is effective for the 1974-75 academic year. The University reserves the right to revise its schedule of tuition and fees without notice.

Full-time, one academic year

Students registered for nine (9) or more credits are considered full-time and are charged the following fees.

Tuition	
Rhode Island residents	$630.00
Out-of-state residents	750.00
Graduate student assessment	40.00
Medical insurance *	18.75
Registration fee	10.00

Part-time, one semester

Students registered for eight (8) credits or less are charged the fees below. Those maintaining continuous registration and registered for no credit are required to pay a registration fee of $30 per semester.

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* All full-time students are required to participate in the University's Student Medical Insurance Program unless they can give evidence of comparable coverage in another plan. This hospital plan has a $20 deductible clause.

Tuition, per credit hour	
Rhode Island residents	$30.00
Out-of-state residents	35.00
Graduate student assessment	1.00
Registration fee	5.00

DIVISION OF UNIVERSITY EXTENSION

See the Division's degree programs bulletin.

SUMMER SESSION

See the Summer Session bulletin.

APPLICATION FEE

Twelve dollars ($12) must accompany each application for admission. See page 13 for application procedure.

ADDITIONAL FEES

Students may be asked to make key deposits and to cover laboratory and other incidental expenses for specific courses.

Master's degree candidates must pay a thesis-binding fee of $4 and doctoral candidates must pay a dissertation-binding and microfilming fee of $30. These fees are due before the candidate submits his dissertation for approval by the Graduate School. All degree candidates must pay a diploma fee of $10.

LATE FEES

A late registration fee of $15 for the first day and $5 for each succeeding day (not including Sundays or holidays) is charged unless excused by the Registrar.

Each course dropped after the conclusion of the "drop and add" period (see page 14) incurs a $5 charge unless the student withdraws from the University.

REMISSION OF FEES

Remission of tuition and the registration fee is granted to holders of tuition scholarships, graduate assistantships and most fellowships and traineeships. This policy does not include graduate research assistants and associates whose stipends are normally larger than those of graduate assistants. The medical insurance fee and the graduate student assessment are both excluded from this remission policy.

REFUNDS

Refunds of payments made or credits against amounts due to the University shall be made to students who officially withdraw according to the scale below. The attendance period in which withdrawal occurs is counted from the first day of registration and includes weekends and holidays.

First two weeks	80%
Third week	60%
Fourth week	40%
Fifth week	20%
After five weeks	No Refund

FINANCIAL AID

There are several forms of financial assistance available to graduate students. To be eligible for any form of assistance, the student must first be admitted to the Graduate School. Detailed information (stipends, allowances, tenure, etc.) on the fellowships, scholarships, traineeships and assistantships described below is available from the Graduate School Office and is included in the *Graduate Student Manual.* Fellowships, traineeships, and scholarships are awarded by the Dean of the Graduate School to students selected from nominees submitted by department chairmen. Students are advised to request nomination for these awards by the chairman of the department in which they plan to study or are currently enrolled at the University.

FELLOWSHIPS

Fellowships are awarded to graduate students in recognition of achievement and promise as scholars. They are intended to enable students to pursue graduate studies and research without rendering any service to the University. A fellow's stipend is not considered compensation, but a gift. Graduate fellows are required to be full-time students and may not engage in additional remunerative work without the specific approval of the Dean of the Graduate School.

Special Fellowships are supported by various industrial firms, private foundations and individuals, and are usually restricted to students in particular areas of study and research. The stipends and supplemental allowances of these fellowships are not uniform.

University of Rhode Island Graduate Fellowships are supported by the Graduate School. A fellowship provides a stipend of $3,000 for the academic year and the remission of tuition. This fellowship gives preference to promising students in recently established doctoral study programs where other fellowship support may not be available.

Public Health Service Predoctoral and Special Fellowships are provided to enhance the competence

and increase the number of professional persons in the medical sciences and other health-related fields. These fellowships are awarded by the National Institutes of Health and by the Bureau of State Services Divisions of Nursing, Air Pollution, and Water Supply and Pollution Control. Applications for these fellowships are made directly to Career Development Review Branch, Division of Research Grants, National Institutes of Health, Public Health Service, Bethesda, Maryland 20014.

GRADUATE ASSISTANTSHIPS AND GRADUATE RESEARCH ASSISTANTSHIPS

Assistantships are awarded to full-time graduate students to provide them with teaching and research training. Assistants may be required to provide service for up to 20 hours per week. Appointments are initiated by department chairmen. To be eligible for such an appointment, the student must first be admitted to the Graduate School. His application for the assistantship should be submitted to the department chairman by February 15. Appointments are announced about April 1.

Graduate Assistants assist, under supervision, with instructional and/or research activities of a department. Not more than ten hours per week will be in classroom contact. Graduate assistant stipends for the 1974-75 academic year range from $2800 to $3200, depending upon qualifications and experience. In addition, tuition and the enrollment fee are remitted for the academic year of the appointment. Additional remuneration is given for any work done during the summer, although such work cannot be guaranteed.

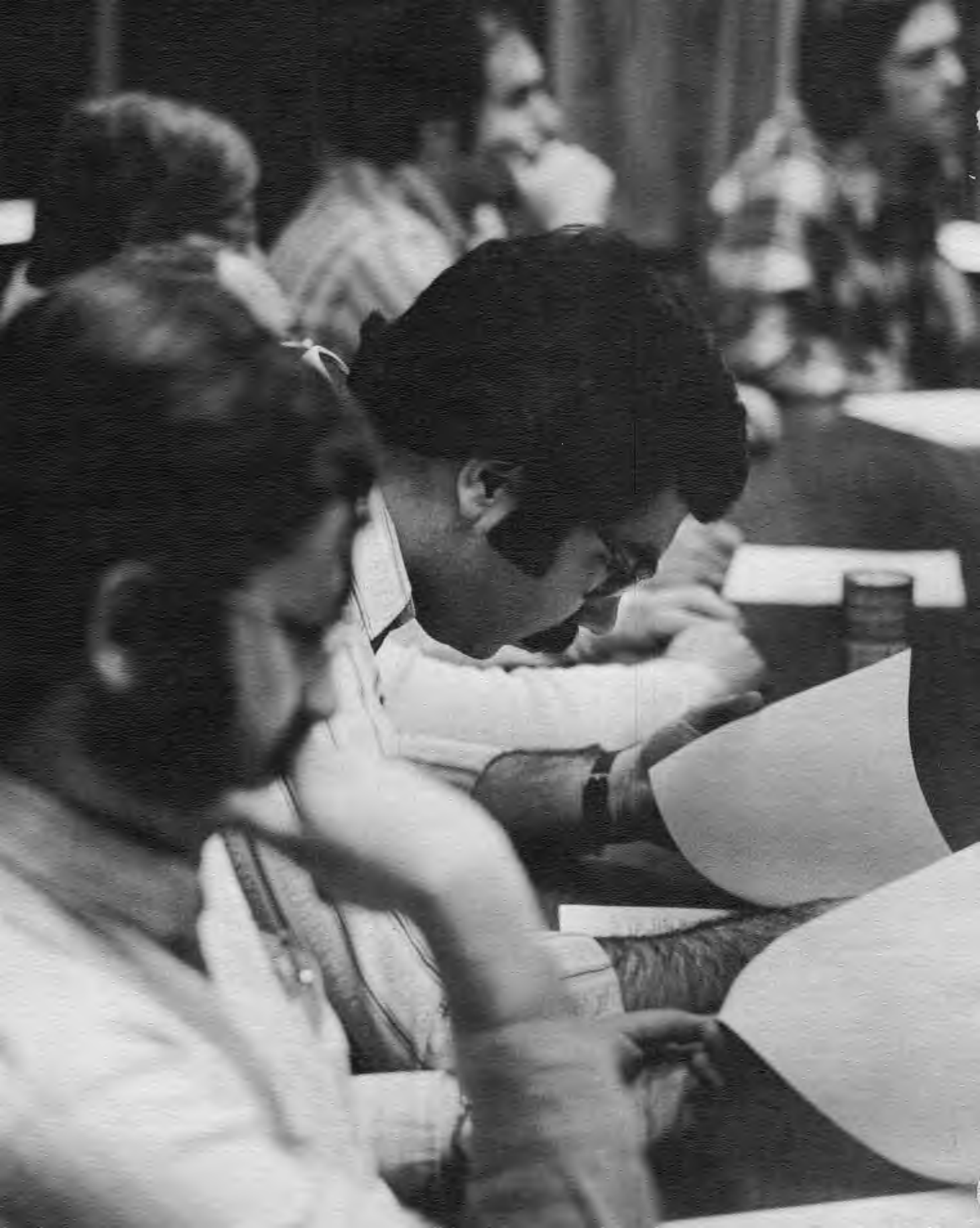
Graduate Research Assistants are assigned to individual research projects sponsored either by the University or by an outside agency. On supported research contracts and grants, the graduate research assistant is judged to be employed on a half-time basis (for a 40-hour week). For this he receives a stipend ranging from $3150 to $4600 for nine months without remission of tuition and fees. Additional remuneration up to $2666 is given for any work done during the summer months.

OTHER ASSISTANCE

Tuition scholarships, which provide for the remission of tuition and enrollment fees, are awarded by the Dean of the Graduate School from University funds. These scholarships are awarded to qualified students demonstrating need of financial assistance. Application forms are available in the Graduate School Office.

Loans for qualified students are available under the National Defense Education Act. Additional information is available from the Student Aid Office in Davis Hall, which administers loans.

Veterans' benefits information may be obtained from the Graduate School Office or from the Counselor for Veterans, Office of the Dean of Students in Green Hall.



Graduate Programs

This section must be read in conjunction with the preceding sections on Degree Requirements and on Admission and Registration. The specific admissions and program requirements listed below are included within the general requirements set forth in the preceding sections, and do not reduce those general requirements. For example, scores on the Verbal and Quantitative Aptitude Tests of the Graduate record Examination (GRE) are required of all applicants unless another nationally-administered test such as the Admission Test for Advanced Study in Business (ATGSB) or the Miller Analogies Test (MAT) is specified below. Scores on the GRE Advanced (subject matter) Tests are required only where specified below.

Where admission to a doctoral program is possible for those holding the bachelor's degree and meeting other requirements, the Graduate School reserves the right to offer admission only to the master's program while postponing a decision on admission to the doctoral program until at least a substantial portion of the master's work has been completed.

Please note that the specific program requirements given on the following pages are minimum requirements. For example, additional course credits may be required for individual candidates whose academic background is insufficient.

ACCOUNTING

M.S., M.B.A.

GRADUATE FACULTY

Associate Professor Martin, *acting chairman*. Professor Sanderson; Associate Professors Vangermeersch, Wood; Assistant Professors Brandon, duBois, Looney, Matoney.

MASTER OF SCIENCE

Admission requirements: undergraduate grade point average of B or above (2.7 on a scale of 4.0) and a score at the fiftieth percentile or above (approximately 475) on the ATGSB examination. Applicants for whom English is not the native language will be expected (in addition to presenting a TOEFL score of at least 575 as a condition for admission) to demonstrate proficiency in written and oral communications, or they will be required to correct deficiencies by taking selected courses for no program credit.

Program requirements: from 30 to 60 credits depending upon undergraduate program. A thesis is optional but the candidate is required to take GBA 671 if he elects the non-thesis option. A written comprehensive examination is required and an oral examination is optional at the discretion of the department.

MASTER OF BUSINESS ADMINISTRATION

See Business Administration program.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

ANIMAL PATHOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Yates, *chairman*. Professor Chang; Assistant Professors Kimball, Wolke; Adjunct Professors Dardiri, Liu.

SPECIALIZATIONS

Pathogenesis of avian adeno and bovine herpes viral infections in cells, embryos, and in avian and mammalian hosts; recovery of viruses from inland estuaries, streams and ponds; the genetic bases for resistance to the avian leucosis complex; diseases of fish.

MASTER OF SCIENCE

Admission requirements: GRE and an undergraduate major in biological science with a concentration in animal science, bacteriology, botany or zoology; mathematics through introductory calculus; quantitative analytical chemistry; and one year of organic chemistry and physics.

Program requirements: thesis and BCH 581, 582; APA 501, 502, 534, 536; MIC 432, 532, 541.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree.

Program requirements: courses listed under M.S. degree and APA 538; BPH 521; MIC 552, 544, 546.

ANIMAL SCIENCE

M.S.

GRADUATE FACULTY

Professor L. T. Smith, *chairman*. Professor Cosgrove; Associate Professors Durfee, Henderson, Hinkson, Kupa, Meade, Millar, Rand; Assistant Professor Gray; Adjunct Professor Coduri.

The department has two research facilities involved with studies in large animals, fish, poultry and game birds. It is involved in cooperative research in the Sea Grant Program, aquaculture; Food Science and Technology Program, gastric zymogens, food enzyme technology and food analysis in a joint program with the R.I. Department of Health. It is also involved in a joint program with the Department of Forest and Wildlife Management in areas of environmental control and wildlife management.

SPECIALIZATIONS

Food science, nutrition, physiology, genetics, aquaculture and wildlife management.

MASTER OF SCIENCE

Admission requirements: GRE. A bachelor's degree in agriculture or biological science is preferred.

Program requirements: thesis.

BIOCHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Purvis, *chairman*. Professors Constantinides, Dain; Associate Professors Bell, Tremblay; Adjunct Professor Hammonds.

SPECIALIZATIONS

Mitochondrial metabolism and transport, comparative biochemistry of the cytochromes, biochemical aspects of endocrinology, neurochemistry, chemical embryogenesis of the nervous system and mechanisms of action of nervous tissue, glycolipid synthetic enzymes, regulation of protein synthesis, pyrimidine metabolism, control of blood coagulation, control of enzyme-activity.

MASTER OF SCIENCE

Admission requirements: GRE with preference given to students with undergraduate majors in chemistry, biology or biochemistry.

Program requirements: thesis and BCH 541, 581, 582; two semesters of seminar (elected from BCH 531, 532, 533, 534); and two courses elected from BCH 601, 602, 611, 612.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree plus passing qualifying examination at Ph.D. level. Master's degree not required.

Program requirements: courses listed under M.S. degree plus BCH 542; an additional two semesters of seminar (elected from BCH 531, 532, 533, and 534); and one additional course elected from BCH 601, 602, 611, 612. Six credits of course work must also be taken from a selection provided by the department. These courses are selected to encourage the student to broaden his background and are not included for program credit. There is no language requirement.

SPECIAL FINANCIAL AID

Graduate teaching assistantships are reserved for advanced Ph.D. students. Research assistantships are available through research awards to individual faculty members.

BIOPHYSICS

M.S., Ph.D (Biological Sciences)

GRADUATE FACULTY

Professor N. P. Wood, *chairman.* Professor Fisher; Associate Professor Hartman; Lecturer Hufnagel.

SPECIALIZATIONS

Electron microscopy, mammalian cell culture and tumor viruses, structure and functions of nucleic acid and ribosomes, structure of viruses, infra-red and Raman spectroscopy.

MASTER OF SCIENCE

Admission requirements: GRE and major in science or engineering; two semesters each in organic and physical chemistry and physics; mathematics through differential equations.

Program requirements: thesis and courses in biophysics, chemistry, physics, biology.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree.

Program requirements: dissertation, a qualifying examination in physical chemistry and two selected from chemistry, physics, or biology. A master's degree may be accepted for one of the qualifying examinations. Comprehensive examination will require knowledge of the biophysics courses and one outside area.

Students in the Molecular Biology Option will take research courses in microbiology, biochemistry and biophysics.

BOTANY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Goos, *chairman.* Professors Albert, Beckman, Caroselli, Hauke, Lepper, Palmatier, Smayda, Wood; Associate Professors Mottinger, Swift; Assistant Professors Halvorson, Hargraves, Harlin; Adjunct Professor Simmons.

SPECIALIZATIONS

Aquatic botany (marine and freshwater), genetics and cytogenetics, mycology, plant development, plant ecology, plant pathology, plant physiology, plant taxonomy.

MASTER OF SCIENCE

Admission requirements: GRE including advanced test and undergraduate major in the sciences. Candidates lacking undergraduate courses in organic chemistry, physics, mathematics through introductory calculus, and fundamental courses in biological sciences may be required to make up deficiencies without graduate credit.

Program requirements: thesis and BOT 581, 582.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree normally required; outstanding candidates may be accepted without the M.S. degree.

Program requirements: one foreign language or proficiency in a research tool.

BUSINESS ADMINISTRATION

M.B.A.

GRADUATE FACULTY

Professor Weeks, *dean,* College of Business Administration; Associate Professor Johnson, *assistant dean and director of M.B.A. program.*

Accounting: Associate Professor Martin, *acting chairman.* Professor Sanderson; Associate Professors Vangermeersch, Wood; Assistant Professors Brandon, duBois, Looney, Matoney.

Business Law: Professor Geffner; Associate Professor Peck.

Finance and Insurance: Professor Poulsen, *chairman.* Professors Brainard, Pitterman; Associate Professors Booth, Fitzgerald; Assistant Professors Dash, Speicher.

Management Science: Associate Professor Sternbach, *acting chairman.* Professor Jarrett; Associate Professor Shen; Assistant Professors Ageloff, Armstrong, Budnick, Mojena, Parsons, Sanghvi, Zartler.

Marketing Management: Professor Alton, *chairman.* Associate Professors Bowman, Hill, Nason; Assistant Professors Della Bitta, Loudon.

Organizational Management and Industrial Relations: Assistant Professor Overton, *chairman.* Professor Coates; Associate Professors deLodzia, Desfosses, Schmidt; Assistant Professors Allen, Raffaele.

The Master of Business Administration program is offered on the Kingston campus for full-time and part-time students and in the evening at the Division of University Extension in Providence for part-time students. Full-time work is preferred and enouraged. Candidates may begin the program in June, September or February of each year. Applications to the Dean of the Graduate School should specify the M.B.A. program and indicate on which campus study is to be undertaken.

SPECIALIZATIONS

Accounting, finance, insurance, management science, marketing management, organizational management and industrial relations, health care administration.

MASTER OF BUSINESS ADMINISTRATION

Admission requirements: undergraduate grade point average of B-minus or above (2.7 on a scale of 4.0) and a score at the 50th percentile or above (approximately 475) on the ATGSB examination. Applicants for whom English is not the native language will be expected (in addition to presenting a TOEFL score of at least 575 as a condition of admission) to demonstrate proficiency in written and oral communications, or they may be required to correct deficiencies by taking selected courses for no program credit.

Program requirements: the non-thesis program (36 credit hours) can be completed in one calendar year by students who satisfy all foundation requirements. Students with no foundation work completed will take two calendar years (60 credit hours) to finish the program. ACC 611; ECN 690; FIN 641, 645; GBA 671; MGS 682; MMG 651; OMR 626, 681; MGS 681 or OMR 627; plus nine credit hours of 500- or 600-level courses in the College of Business Administration or outside of the College of Business Administration, provided the student obtains prior permission from the M.B.A. director.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

BUSINESS EDUCATION

M.S.

GRADUATE FACULTY

Assistant Professor Langford, *chairman.* Associate Professors Smith, Sink; Assistant Professor Clark.

SPECIALIZATIONS

Administration and supervision of business education, use of audiovisual equipment and materials in business education, consumer education, innovations in teaching business education, survey of office and distributive occupations, cooperative education programs, business communications.

MASTER OF SCIENCE

Admission requirements: undergraduate grade point average of 2.5 or above (scale of 4.0) and a 40th percentile ranking or above on the MAT examination for conditional admission; undergraduate grade point average of 2.7 or above and a 50th percentile ranking or above on the MAT examination for full admission.

Program requirements: undergraduate credit hours in accounting, finance, economics, marketing, management, production, statistics and business law. Candidates lacking undergraduate courses in business education may be required to make up deficiencies. Thirty credit hours without a thesis, including BED 524, 525, 526; six credits selected from BED 520, 522, 528; three credits in economics numbered above 400; three credits selected from EDC 572 and BED 428; six credits in academic business subjects selected from accounting, business law, computer science, economics, finance, insurance, management science and marketing management courses; plus three credits of graduate-level free electives numbered above 500.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

CHEMICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Treybal, *chairman.* Professors Gielisse, Madsen, Mairs, Mohrnheim, Shilling, Thompson; Associate Professors Knickle, Rockett, Rose; Assist-

ant Professor Barnett; Adjunct Assistant Professors Shagian, Spano.

SPECIALIZATIONS

Adsorption, biochemical engineering, biomedical engineering, boiling heat transfer, catalysis, ceramics, corrosion, desalination, dispersion processes, distillation, fluid dynamics, heat transfer, ion exchange, kinetics, liquid extraction, mass transfer, materials engineering, membrane processes, metal finishing, metal oxidation, metallurgy, nuclear technology, phase equilibria, pollution control, polymers, process dynamics, thermodynamics, water resources, X-ray metallography.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in chemical engineering. Candidates from other engineering fields or from mathematics, biology chemistry or physics may be accepted into the program with possible addition of prerequisite courses.

Program requirements: thesis or non-thesis option (within master's examination, comprehensive report with oral examination); CHE 501, 502.

DOCTOR OF PHILOSOHY

Admission requirements: GRE and M.S. degree in engineering (may be waived for University of Rhode Island graduate students who pass qualifying examination with superior performance).

Program requirements: a candidate's program will be determined in consultation with his committee and be based on his background and career goals. There is no general language requirement but a student's committee may require a foreign language or research tool which may be necessary for the student's program. In addition to an acceptable dissertation, a candidate must submit the manuscript of a paper, based on his research, suitable for transmittal to a technical journal; CHE 501, 502.

CHEMISTRY

M.S., Ph.D.

GRADUATE FACULTY

Professor Goodman, *chairman*. Professors Abell, Kraus, MacKenzie, Rosie, Vittimberga; Associate Professors C. Brown, Cheer, Fasching, Gonzalez, Nelson, Petersen; Assistant Professors P. Brown, Burdo, Hamlet, Kirschenbaum, Rosen.

SPECIALIZATIONS

Theoretical aspects include quantum mechanics, molecular orbital calculations, spectral interpretations, reaction mechanisms and kinetics (organic and inorganic), computer simulation, and hyperreactive intermediates. Analytical and structural studies employ spectral methods, mass spectrometery, light scattering, surface chemistry, photochemistry, organometallic compounds, X-ray crystallography, electrochemistry, neutron activation analysis, and gas chromatograph. Applications to contemporary problems include studies in ancient organic residues, drug-receptor interactions, nucleosides, chelatable polymers, heterocycles, air and ocean analyses, alkali metal superoxides, and liquid crystals.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test. Minimum TOEFL score of 560. Preference is given to candidates with undergraduate majors in chemistry or chemical engineering with mathematics through calculus.

Program requirements: for thesis option (30 credit hours), requires 12 credit hours of graduate core courses in at least three of the four areas of chemistry, CHM 641 or 642 and thesis; for nonthesis option (36 credit hours), requires 18 credit hours of graduate core courses, CHM 641 or 642 and CHM 551, 552.

DOCTOR OF PHILOSOPHY

Admission requirements: same as for master's degree.

Program requirements: 18 credit hours of graduate core courses, CHM 641, 642; language, reading proficiency in one foreign language (French, German or Russian) or a research tool (computer science).

CHILD DEVELOPMENT AND FAMILY RELATIONS

M.S.

GRADUATE FACULTY

Associate Professor Cohen, *chairman*. Professors Fitzelle, R. C. Smart; Associate Professor Spence; Assistant Professors Cooper, Greene; Adjunct Professor M. S. Smart.

SPECIALIZATIONS

Social and personality development in children, family life education, early childhood development.

MASTER OF SCIENCE

Admission requirements: fall admission; GRE and 18 undergraduate credit hours distributed among at least thee of the following areas: child development and family relations, psychology, sociology, biology, education.

Program requirements: 24 course hours plus 6 credits toward thesis (30 credit hours) or 24 course hours plus 6 related action thesis credits (30 credit hours).

CIVIL AND ENVIRONMENTAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Associate Professor McEwen, *chairman.* Professors Campbell, Nacci; Associate Professors Lavelle, Moultrop, Poon, Wang; Assistant Professors Fang, Kelly, Marcus, Sussman.

SPECIALIZATIONS

Water supply and treatment facilities, municipal and industrial waste treatment, ground water seepage, flocculation and coagulation of wastes, phosphate and nitrate removal, air pollution, solid waste management, modeling of environmental systems, physico-chemical properties of ocean sediments, soil stabilization, thermal properties of soils, adsorption on minerals and clays, sampling of ocean sediments, marine structures, optimum structural design, thin-walled structures, structural stability, experimental stress analysis, flexible and rigid pavement design, curved highway bridges.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in civil or environmental engineering. Candidates in other engineering fields or in mathematics, biology, chemistry or physics may be accepted with the possible addition of prerequisite courses.

Program requirements: thesis or non-thesis option. 30 credit hours plus CVE 601, 602; a minimum of two courses taken outside the department. Non-thesis option requires comprehensive report.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and master's degree in civil or environmental engineering or in a related field.

Program requirements: 30 course credits beyond the master's degree; one language; a three course and a two course minor from outside the department which may include work at the master's level.

COMMUNITY PLANNING AND AREA DEVELOPMENT

M.C.P.

GRADUATE FACULTY

Associate Professor Feast, *director.* Professor Jeffrey; Associate Professors Brooks, Foster, Hammerschlag, Kumekawa; Assistant Professor Mahayni; Instructor Johnson; Adjunct Professor Thomas.

SPECIALIZATIONS

In addition to the core of generic planning, three concentrations in regional, environmental and inner-city planning. An alternative concentration in a specialized field of planning may be developed by self-directed students, e.g., health, urban design, administration, quantitative analysis, land use.

MASTER OF COMMUNITY PLANNING

Admission requirements: GRE; undergraduate background in the social sciences, architecture, landscape architecture, engineering or geography preferred. Students are normally not admitted for February matriculation and only a limited number of part-time students can be admitted. Applications should be completed by March 15.

Program requirements: CPL 503, 504, 505, 508, 510, 601, 603, 606 or 608; EST 408; thesis; summer internship or equivalent professional experience. The two-year program of 60 credit-hours is distributed one-half in core courses and about one-half in elected concentration and thesis. Students normally take 15 credits per semester.

COMPUTER SCIENCE

M.S.

GRADUATE FACULTY

Professor Hemmerle, *chairman.* Professor Carney; Assistant Professors Bass, Carrano, Tetreault, Weiderman.

SPECIALIZATIONS

Operating systems, statistical computations simulation, numerical analysis, artificial intelligence, programming languages, information retrieval, performance evaluation, theory of computation, computer-aided education, computer organization.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with a minimum of 18 credit hours in mathematics, statistics, or computer science including the equivalent of MTH 141, 142 Introductory and Intermediate Calculus with Analytic Geometry; MTH 243 Calculus and Analytic Geometry of Several Variables; MTH 215 Introduction to Algebraic Structures; and CSC 410 Introduction to Computer Science and Algorithmic Processes. GRE-V, GRE-Q and GRE-advanced test in mathematics or undergraduate major field are required for admission.

Program requirements: a minimum of 24 credits (exclusive of thesis) is required. At least 12 of these credits must be in computer science courses at the 500 level (exclusive of CSC 591, 592 unless approved by the major professor and department chairperson). Every candidate must complete CSC 411 and at least one course from each of the following four groups: 1) CSC 412 or 413, 2) CSC 500 or 551, 3) CSC 502 or 515, 4) CSC 525 or 535. A thesis is required.

ECONOMICS

M.A.

GRADUATE FACULTY

Professor Sabatino, *chairman.* Professors Dirlam, Haller, Hellman, Norton, Rayack, Schurman; Assistant Professors Barnett, Starkey, Suzawa, Ramsay; Instructor Hume.

SPECIALIZATIONS

Economic development, economic theory, industrial organization, international economics, money and banking, public finance, econometrics, mathematical economics.

MASTER OF ARTS

Admission requirements: GRE scores for verbal and quantitative tests and, normally, some undergraduate training in economics. Some training in mathematics and statistics is also desirable.

Program requirements: thesis or non-thesis option, 30 credit hours, including, for Track I, ECN 512, 527, 528, 575, 576, and 515 or 516 or thesis. This track is strongly advised for students desiring to pursue further studies in the mainstream of contemporary thought or to prepare themselves for professional work in business, government and teaching at the university level. For Track II, ECN 512, 527, 528 and 515 or 516 or thesis. This track is available to students who prefer a wider range of courses and more freedom of choice.

EDUCATION

M.A.

GRADUATE FACULTY

Professor MacMillan, *chairman.* Associate Professor Purnell, *coordinator of graduate studies.*

Educational Research: Associate Professors Purnell, Soderberg; Assistant Professors Allen, Long, Pezzulla, Schaffran, Sullivan.

Elementary Education: Professor Nally; Associate Professors W. P. Kelly, Nagel; Assistant Professors Sullivan, Whitcomb.

Guidance and Counseling: Professor Rife; Associate Professors Gunning, Pascale; Assistant Professor Maynard.

Reading: Professor Aukerman; Associate Professors Bumpus, McGuire; Assistant Professor Baker.

Science Education: Associate Professor Croasdale; Assistant Professor Kellogg.

Secondary Education: Professors Casey, Russo; Associate Professor Heisler; Assistant Professors Allen, Calabro, Hagey, Howard, Long, Nelson, Willis.

Youth and Adult Education: Associate Professors Bromley, McCreight; Instructor Jones.

Enrollment of foreign students is limited; a minimum TOEFL score of 600 is required.

The Master of Arts degree is offered in the following areas of study. Applicants should specify the area of specialization on the application form.

EDUCATIONAL RESEARCH

Admission requirements: MAT or GRE, teaching certificate, strong background in mathematics or statistics.

Program requirements: thesis; EDC 503, 514 or 574, 529, 570 or 571; PSY 410, 434, 510, 520; computer science elective.

ELEMENTARY EDUCATION

Admission requirements: MAT and teaching certificate, one year teaching experience desirable.

Program requirements: thesis or non-thesis option. EDC 503, 529; 18-24 hours of education electives including six hours for thesis or non-thesis seminar and six credit hours taken outside education offerings.

GUIDANCE AND COUNSELING

Admission requirements: MAT, teaching experience at elementary or secondary school desirable for counseling at these levels, personal interview. Applications for summer, fall, and spring admissions reviewed by March 15 and October 15, respectively.

Program requirements: thesis or non-thesis option. EDC 450, 529, 550, 551, 552, 553, 554, 555, 556; PSY 434. Six additional hours as planned with adviser.

READING

Admission requirements: MAT and teaching certificate, teaching experience under contract.

Program requirements: thesis or non-thesis option. EDC 503, 529; PSY 434; 24 credit hours of courses approved for the preparation of reading specialists including six credit hours of clinic or practicum experience, and one or more electives.

SCIENCE EDUCATION

Admission requirements: MAT and teaching certificate, undergraduate major in science, interview with faculty.

Program requirements: EDC 529; 12-18 credit hours of education electives including six hours of thesis or non-thesis seminar and a minimum of 12 hours of science courses.

SECONDARY EDUCATION

Admission requirements: MAT or GRE and teaching certificate, one-year teaching experience desirable, undergraduate major in academic area of secondary education, interview with appropriate faculty.

Program requirements: thesis or non-thesis option. EDC 503, 529; 571, 572, or 574; additional 6-12

credit hours of education courses including six hours for thesis or non-thesis seminar and a minimum of 12 credit hours in academic area.

YOUTH AND ADULT EDUCATION

Admission requirements: MAT, teaching certificate or sound background in general education and/or social sciences, interview with program faculty.

Program requirements: thesis or non-thesis option. EDC 505, 529; 580, or 581; 582, 583, or 584; 585; and a minimum of 18 credit hours of education or other electives including six hours of thesis or non-thesis seminar. All courses are offered in late afternoon and/or evening.

ELECTRICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Polk, *chairman.* Professors Haas, Lengyel, Lindgren, Mitra, Spence, Tufts; Associate Professors Daly, Etzold, Jaron, Mardix, Poularikas, Sadasiv; Assistant Professors Birk, Kelley, Krikorian; Adjunct Professors Biberman, Hall, Kazan, Middleton, Zirkind; Visiting Professor Seely.

SPECIALIZATIONS

Biomedical Engineering: instrumentation, pattern recognition, X-ray holography, biological effects of electromagnetic radiation, cardiovascular modeling, control of cardiovascular assist devices, medical diagnostic techniques, health science application of computers—in cooperation with Rhode Island Hospital. *Acoustics and Underwater Acoustics:* information processing in acoustic channels, speech recognition, architectural acoustics, "noise pollution" studies. *Solid State Electronics and Photoelectronic Imaging Devices:* optical properties of non-metallic solids, solar cell development, heterojunction structures, development of photocathodes and photodetector arrays, performance analysis of displays and of imaging devices for infrared to X-ray spectrum. *Communication and Digital Systems:* computer graphics, multi-processing, data compression, digital filtering, pattern recognition. *System Dynamics and Control:* time varying and distributed parameter systems, electro-optical systems, digital control for prosthetic devices and industrial robots. *Electromagnetic Wave Propagation, Optics and Plasma Dynamics:* tropspheric and ionospheric propagation, atmospheric electricity, ELF noise and geomagnetic micropulsations; optical waveguides; optical computing and information processing; applications of holography.

MASTER OF SCIENCE

Admission requirements: GRE and B.S. in electrical engineering, engineering science, physics, mathematics, or computer science. Preparation in related fields such as aeronautical, civil, chemical and mechanical engineering or in the life sciences may be acceptable.

Program requirements: thesis or non-thesis option. Individual programs are designed in accordance with the students' backgrounds and interests. Thesis or non-thesis option: minimum of 18 credit hours in electrical engineering; 12 credit hours either in electrical engineering or in other areas of science and engineering. Programs of study require departmental approval.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and M.S. degree or equivalent in electrical engineering, engineering science, physics, mathematics or computer science.

Program requirements: for the comprehensive examination, background in several of the following areas is required—linear and non-linear systems, communication and control systems, design of digital systems, electromagnetic theory and solid state physics. Most students find it essential to become thoroughly familiar with the application of digital computer techniques. Dissertation research makes use of major, modern laboratories in the listed areas of specialization.

ENGLISH

M.A., Ph.D.

GRADUATE FACULTY

Professor Miller, *chairman;* Professor MacLaine, *director of graduate studies.* Professors Goldman, Gullason, Hoffmann, Neuse, Petrie, Potter, Robinson, Smith, Sorlien, Steeves, White; Associate Professors Barker, Joel, Kunz, Marshall, Mathews, McCabe, Murphy, Seigel, Sharpe, Towers, Tutt; Assistant Professors Campbell, Cane, Collins, Dvorak, Hills, Jacobs, Leo, Malina, Reaves.

SPECIALIZATIONS

For the M.A., American literature, English literature, comparative literature, literary criticism; *for the Ph.D.*, dissertation work is available in all fields of English and American literature.

MASTER OF ARTS

Admission requirements: GRE and a minimum of 21 credits in English with a B average in all English courses.

Program requirements: thesis; or for non-thesis option, two 600-level seminars and comprehensive examination in three fields.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE with advanced test and M.A. in English or equivalent. Early application is desired due to limited enrollment.

Program requirements: reading knowledge of one foreign language is required, unless such requirement is waived by the program committee in consultation with the director of graduate studies.

ENVIRONMENTAL BIOLOGY

The Institute of Environmental Biology is an administrative organization consisting of faculty members active in graduate training and research in botany, electrical engineering, forestry, oceanography, pharmacology, zoology, and of adjunct faculty members in associated federal and private laboratories, who provide an interdisciplinary approach to problems in environmental biology. Programs are designed to produce environmental biologists trained in depth in one academic discipline, but equipped to cross the usual boundaries between disciplines and cope with the larger problems of man and his environment.

Qualified students may become candidates for advanced degrees in the Departments of Civil, Electrical, and Mechanical Engineering; Botany; Food and Nutritional Science; Pharmacology; and Zoology; and in the Graduate School of Oceanography. Students must meet all requirements of their respective departments and colleges, and of the Graduate School. Degree requirements are listed under the degree-granting departments.

Information is available from chairmen of the degree-granting departments or from Professor William L. Halvorson, Ph.D., director, Institute of Environmental Biology, c/o Department of Botany.

ENVIRONMENTAL HEALTH SCIENCES

An interdisciplinary program leading to a master of science degree in Environmental Health Sciences provides graduate training for persons interested in careers in laboratories of state departments of health or in those of federal agencies. Graduates of programs in several areas of biological, physical and health sciences, or in engineering who have developed an interest in public health should, in most cases, have the necessary prerequisites. The student's course of study is planned by an interdepartmental faculty committee and includes work in air pollution, sanitation, food microbiology and chemistry, and public health law and administration. Applicants must submit GRE scores. Information is available from the director of the program, Professor Leonard R. Worthen, Department of Pharmacognosy.

EXPERIMENTAL STATISTICS

M.S.

GRADUATE FACULTY

Professor Hemmerle, *chairman*. Professors Carney, Merenda, Smith; Associate Professor Lawing; Assistant Professors Hanumara, Heltshe.

SPECIALIZATIONS

Experimental design, multivariate methods, statistical computations, sequential methods, non-parametric methods, sampling methods, industrial statistics, genetics, psychometrics.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with credits in mathematics, statistics, or computer science, including the equivalent of MTH 141, 142, Introductory and Intermediate Calculus with Analytic Geometry; MTH 243, Calculus and Analytic Geometry of Several Variables; MTH 215, Introduction to Algebraic Structures; CSC 201, Introduction to Computing; MTH 451, Introduction to Probability and Statistics or EST 409, Statistical Methods in Research I. GRE-V, GRE-Q, and GRE-advanced test in mathematics are required for admission.

Program requirements: a minimum of 24 credits (exclusive of thesis) is required. MTH 451, EST 409, and EST 412 are required; however, a maximum of six credits in these courses may be applied as program credit. All candidates must complete

twelve credits at the 500 level; nine of these credits must be selected from: EST 500, 511, 520, 541, 550. A thesis is required.

FOOD AND NUTRITIONAL SCIENCE

M.S.

GRADUATE FACULTY

Professor Dymsza, *chairman.* Professor Constantinides; Assistant Professors Bergan, Caldwell; Adjunct Professor Silverman.

The department offers a wide variety of individualized programs in close association with other departments such as Animal Science, Biochemistry, Child Development and Family Relations, Fisheries and Marine Technology, Food and Resource Chemistry, Home Economics Education, Microbiology, and Pharmacology and Toxicology. These graduate programs are enriched by departmental participation in the Sea Grant Program, the AID-supported International Center for Marine Resource Development, the Institute of Environmental Biology, the interdepartmental program in food science, the University gerontology program, and community and state nutrition programs. Work beyond the M.S. degree may be developed with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS

Marine food preservation, food enzymology, utilization of fish and marine species, food safety, human nutrition and dietetics, nutritional status evaluation, nutritional biochemistry and metabolism, marine and new food sources, nutrition of fish and marine food organisms, nutrition education, international and domestic public nutrition improvement programs.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree with adequate preparation for the proposed area of study.

Program requirements: thesis and graduate courses approved by department.

FOOD AND RESOURCE CHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Felbeck, *chairman.* Professors Chichester, Olney, Salomon, Simpson; Associate Professor Rand; Assistant Professors Bergan, Lee; Adjunct Associate Professor Zaroogian.

There is a close relationship in graduate study with the Departments of Biochemistry, Biophysics, Chemistry, Food and Nutritional Science, Animal Science, and Plant and Soil Science, and the Graduate School of Oceanography.

SPECIALIZATIONS

Food biochemistry, soil biochemistry, pesticide chemistry, soil chemistry, plant biochemistry, chemistry of agricultural and marine products.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in agricultural science, a biological science, or chemistry, at least one year of organic chemistry.

Program requirements: thesis and advanced courses in biochemistry and chemistry.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: some as for master's degree, and M.S. degree with thesis requirement.

Program requirements: dissertation and advanced courses in biochemistry and chemistry.

FRENCH

M.A.

GRADUATE FACULTY

Professor Capasso, *chairman,* Department of Languages; Professor Waters, *section head.* Professors Porter, Rothschild; Associate Professor Hyland; Assistant Professors Benson, Chartier, Kuhn, Morello, Rogers, Toloudis.

SPECIALIZATIONS

French literature, black-French studies, linguistics.

MASTER OF ARTS

Admission requirements: GRE or MAT; 24 semester hours, or equivalent, of French, of which a minimum of nine must be literature; approximately a B average in undergraduate work.

Program requirements: thesis, eight 500-level courses and comprehensive examination; or for non-thesis program, ten 500-level courses and comprehensive examination. FRN 471 and/or 472 may be substituted for 500-level courses in either the thesis or the non-thesis program.

GEOGRAPHY

M.A.

GRADUATE FACULTY

Professor Alexander, *chairman*. Professors Higbee, Michel; Associate Professor Havens; Assistant Professor Capelle; Instructor Krausse.

SPECIALIZATIONS

Marine geography, political and economic geography, comparative urban processes and land utilization, meteorology and climatology, North America and the North Atlantic region, quantitative and cartographic methods.

MASTER OF ARTS

Admission requirements: GRE. The advanced examination in geography is not required, but candidates should have, or be prepared to make up without graduate credit, the equivalent of 12 credits of introductory work in physical geography (or earth science), cultural, economic, and political geography. Another 15 credits in related social or natural sciences are desirable, as are introductory courses in cartography and computer science.

Program requirements: thesis and, normally, GEG 421, 502, 591 or 592.

An interdisciplinary program involving 18 additional credits in geography, history, and political science leads to a Graduate Certificate in North Atlantic Regional Studies awarded by the Dean of the Graduate School as an adjunct to the M.A. in geography.

GEOLOGY

M.S.

GRADUATE FACULTY

Professor Cain, *chairman*. Associate Professors Fisher, Hermes, Tynan; Assistant Professors Frohlich, Hampton.

SPECIALIZATIONS

Coastal geology (geomorphology, sedimentology); experimental sedimentology; igneous and metamorphic petrology-geochemistry; analytical geochemistry; applied geophysics; resources and environmental studies; geohydrology; palynology. Individual programs may include courses and/or research in conjunction with the Graduate School of Oceanography. Interdisciplinary studies are encouraged.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in science or engineering. By the end of the first year, students lacking an undergraduate major in geology will be required to demonstrate, through course work and/or a qualifying examination, satisfactory knowledge of geology and related fields.

Program requirements: thesis, written comprehensive examination in addition to defense of thesis.

HISTORY

M.A.

GRADUATE FACULTY

Associate Professor Briggs, *chairman*. Professors Findlay, Klein, Metz, Weisbord; Associate Professors Cohen, Gutchen, Kim; Assistant Professors Brown, Bryan, Costigliola, Daniel, Honhart, Roughton, Schach, Silvestri, Strom, Thurston.

SPECIALIZATIONS

American history; diplomatic history; East Asian, African, black, Latin American and women's history; imperialism; history of science; modern English history; modern Europen history; state and local history. Degree programs are offered in American History, European History before 1789, European History since 1789, and in Third World Area Studies.

MASTER OF ARTS

Admission requirements: GRE (advanced test desirable) and bachelor's degree with at least 24 credits in history. Majors in related fields may be admitted with permission of the department.

Program requirements: thesis option (30 credit hours) to include four courses at 500 level, at least one of which must be a colloquium and one must be a seminar; non-thesis option (30 credit hours) to include five courses at the 500 level, at least one of which must be a colloquium and two must be seminars. Both options require a four-hour written examination and an oral examination. Two courses in a related field are allowed.

HOME ECONOMICS EDUCATION

M.S.

GRADUATE FACULTY

Associate Professor P. S. Kelly, *director*. Associate Professors MacKenzie, May; Assistant Professor Cooper.

The M.S. in Home Economics Education is interdepartmental within the College of Home Economics. The graduate student's program is planned on an individual basis considering the student's needs and interests, past educational and professional experiences, and future goals. Home Economics Education will be emphasized with additional courses chosen from one of the following home economics subject matter areas: 1) management and consumer education, foods and nutritional science, textiles and clothing, and/or child development and family relations; or 2) selection of one or two courses from each of the areas listed above; plus additional courses selected from related areas such as education, psychology, sociology, economics, business, and resource development.

The Home Economics Education program also offers courses to meet the Rhode Island certification requirements for a permanent teaching certificate. Thirty-six credits or an M.S. are required within six years of receiving one's Provisional Secondary Certificate in Home Economics.

SPECIALIZATIONS

Innovative practices in methods and teaching techniques, leadership development in supervision and administration, curriculum development with an in-depth specialization in a home economics subject matter area, and home economics at the elementary through adult levels.

MASTER OF SCIENCE

Admission requirements: B.S. or B.A. in home economics with certification for teaching; experience or interest in teaching home economics; GRE and GRE Advanced Test in Education.

Program requirements: for thesis option (30 credits), thesis, research methods course, basic knowledge of statistics, four-hour written comprehensive examination, two-hour oral defense of thesis; for non-thesis option (36 credits), action research project, research methods course, four-hour written comprehensive examination, oral presentation of action research project.

INDUSTRIAL ENGINEERING

M.S.

GRADUATE FACULTY

Professor James, *chairman*. Professor Nichols; Associate Professors Black, Branson, Lawing, Rubinsky; Assistant Professor Shao.

SPECIALIZATIONS

Production systems, materials processing-metrology, control systems, operations research, applied statistics, quality control and reliability, inventory control, stochastic processes, industrial-ocean engineering, health systems.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test and B.S. degree in industrial engineering. An applicant with a B.S. degree in another field of engineering, or in mathematics or computer science will be considered; generally, such applicants will be required to complete some deficiency courses.

Program requirements: thesis or non-thesis option. One course each in operations research and computer science, two courses in probability-statistics, or equivalent.

SPECIAL FINANCIAL AID

Research assistantships, part-time professional employment in local industries and hospitals.

INTERNATIONAL STUDIES

International studies are represented by international orientations in many graduate programs as well as by the specialized programs described below. The International Studies Committee is charged with the overall task of developing policy, coordinating programs, and monitoring the University's work in this area. It includes representatives of the Graduate School, the Graduate Student Association, the International Student Affairs Office, the Graduate School of Oceanography, the College of Business Administration, the College of Engineering, the College of Resource Development, the Law of the Sea Institute, the Master of Marine Affairs Program, and the Departments of Economics, Education, Geography, History, Languages, and Political Science in the College of Arts and Sciences.

Inquiries concerning international orientations available through various combinations of electives within existing degree programs may be addressed to the department in which the student plans to enroll or to Peter J. Gielisse, Ph.D., *chairman,* International Studies Committee, c/o the Graduate School. Further information may also be obtained from Russell C. Smart, Ph.D., adviser for International Studies, or Theodore Suddard, director for International Student Affairs.

SPECIALIZATIONS

Master of Arts in Political Science with International Relations Specialization. The Department of Political Science offers over 20 courses in international relations and area studies enabling students to fashion programs suitable to their special interests. To insure an interdisciplinary approach, the department encourages students to take up to 12 credits of relevant course offerings in economics, history, geography, or sociology. For requirements, see Political Science.

Graduate Certificate Program in International Development Studies. A five-course, 15-credit program leading to a Graduate Certificate awarded by the Dean of the Graduate School is offered in each spring semester by the Departments of Economics, Geography, Political Science, and Resource Economics. The Department of Sociology and Anthropology also participates in certain aspects of this new program. Sponsored by the University's International Studies Committee and supported by the University's International Center for Marine Resource Development, this graduate certificate program is designed to provide a supplemental, interdisciplinary concentration on the problems and processes of modernization and international development. The program is open to holders of the master's degree (or its equivalent) in one of the participating disciplines as well as to candidates for such a degree at the University of Rhode Island.

The program is functional in design. It is built around a core interdisciplinary seminar, two more specialized seminars or courses in political science and economics, and a directed studies course in which the student engages in individualized research under the guidance of an indepartmental panel. This research course allows each student to pursue a topic of particular interest to him. In addition, the student chooses an elective course from a list of which at least four of five choices should be available in any semester. Thus, it is possible to complete the entire program in a single spring semester, a factor of importance to those on leave form other institutions or governmental and international agencies.

Requests for further information and for application forms should be directed to the Dean of the Graduate School. Initial inquiries should indicate in which of the above disciplines, and from which institution, the applicant holds the master's degree, or whether he is interested in pursuing the master's degree at this University concurrently with the graduate certificate program, and where his particular research interests lie. Such information will assist the administering committee in selecting an adviser for the student and in designing a program adapted to his needs.

Graduate Certificate in North Atlantic Regional Studies. Designed to take advantage of the University's location in a northeastern state with a strong tradition of involvement in maritime and naval affairs, and with strong commercial and cultural ties with Western Europe, this program is an adjunct to the M.A. degree in geography or in political science. It is open both to University of Rhode Island degree candidates in these departments and to those who have already received an equivalent master's degree from other institutions. Successful completion results in the award of the Graduate Certificate by the Dean of the Graduate School.

The program requires two core courses plus four electives. The core courses are GEG 545 and a directed study or research course in geography or political science in which the student prepares and defends a substantial paper under the direction of a faculty committee. The four electives may be chosen from GEG 441, 443, 543, 571; HIS 411, 418; PSC 301, 431, 464, 472, 513. Assistantships or scholarships are not available for participants in the Graduate Certificate Program as such, but may be held by students who are concurrently enrolled in the M.A. programs in geography or political science.

Additional information is available from the chairman of the Department of Geography.

LIBRARY SCIENCE

M.L.S.

The Master of Library Science program is accredited by the American Library Association.

GRADUATE FACULTY

Professor Humeston, *dean,* Graduate Library School. Associate Professors Bergen, Chin, Healey, Salvatore, Schneider; Assistant Professors Bohnert, Daniel, Tryon.

SPECIALIZATIONS

Readers's services, technical services, information science, bibliography and services in public school, college and university and special libraries.

MASTER OF LIBRARY SCIENCE

Admission requirements: MAT or GRE and the bachelor's degree. Applicants are admitted for June and September *only*. Because of the limitations on enrollments, all materials required for application should be received by the Graduate School by February 15 for June admission and by April 15 for September admission. For the same reason it may happen that some applicants meeting requirements will be denied admission because other applicants present stronger credentials. Notification of acceptance or rejection for June admission will normally be in late March and for September admission normally in late May.

Program requirements: 36 credit hours, 27 or more in library science; LSC 500, 502, 503, 504 and 505, and one course selected from LSC 520, 521, 522 or 523.

MARINE AFFAIRS

M.M.A.

GRADUATE FACULTY

Professors Alexander (geography), *director;* Knauss (oceanography), *provost for marine affairs.* Professors Marshall (oceanography), Rorholm (resource economics), Sheets (ocean engineering); Assistant Professors Fisher (geology), Gamble (marine affairs); Instructor Cameron (marine affairs).

This 30-credit program is for those persons interested in problems of evaluation, use and control of the marine environment. Normally the work is completed in nine months of intensive, full-time resident study with considerable independent responsibility on work projects and substantial written work. It is administered by a committee from the Departments of Resource Economics, Geography, Geology, Ocean Engineering, Political Science, and the Graduate School of Oceanography.

SPECIALIZATIONS

Regimes for the deep seas, decision inputs for coastal zone regulation, jurisdictional requirements for pollution controls, criteria for deciding among competing uses for the continental shelf, applications of cost-benefit analysis to systems models for coastal decisions, implications of treating ocean basins as distinct regions, regulation of the high seas fisheries, impact of ocean engineering advances on the definition of the continental shelf, and legal problems of international scientific expeditions.

MASTER OF MARINE AFFAIRS

Admission requirements: GRE, MAT (in exceptional cases), ATGSB, or LSAT: prior graduate degree or equivalent experience in marine areas. Applicants are admitted for September only.

Program requirements: non-thesis program, REN 514, GEG 571, OCE 500, OCG 401 or appropriate oceanography substitute, PSC 464, MAF 651, 652.

SPECIAL FINANCIAL AID

Marine affairs fellowships up to $4000 are available.

MATHEMATICS

M.S., Ph.D.

GRADUATE FACULTY

Associate Professor Ladas, *chairman.* Professors Driver, Haggerty, Roxin, Suryanarayan; Associate Professors Beauregard, Datta, Fraleigh, Liu, Schwartzman, Sine, Verma; Assistant Professors Barron, Caldwell, Finizio, Grove, Levine, Lewis, Montgomery, Pakula, Papadakis.

SPECIALIZATIONS

Ordinary, functional, and stochastic differential equations, partial differential equations, abstract differential equations, functional analysis, approximation theory, probability, fluid mechanics, control theory and differential games.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test in mathematics.

Program requirements: 30 credit hours (or 24 plus thesis) including at least 18 credits in mathematics of which at least 12 must be at the 500 level or higher. Recommended courses include MTH 513, 515, 525, 535, 536, and 562.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE, including advanced test in mathematics.

Program requirements: MTH 513, 515, 525, 535, 536, and 562, plus specialized courses and electives. Two languages chosen from French, German, Russian; or one of these and computer science as a research tool. The M.S. comprehensive examination serves as the written portion of the department's Ph.D. qualifying examination. This is followed by an oral qualifying examination.

MECHANICAL ENGINEERING AND APPLIED MECHANICS

M.S., Ph.D.

GRADUATE FACULTY

Professor Nash, *chairman.* Professors Bradbury, G. Brown, Conta, Dowdell, Ferrante, Schenck, Test, White; Associate Professors DeLuise, Goff, Hagist, Hatch, Kim, Parker, Velletri, Wilson; Assistant Professors Lessmann, Palm; Visting Lecturer D. Brown.

SPECIALIZATIONS

Interdisciplinary studies, energy conservation, boundary layer theory, ecological systems modeling, flow noise, direct energy conversion, low pollution powerplants, socio-technological problems, analysis of nonlinear systems, global problems, design, hydrodynamics, gasdynamics, magnetofluid-mechanics, two-phase flow, turbulence, fluidics, flow instrumentation, heat transfer, thermodynamics, elasticity, plasticity, materials, vibration, fatigue failure and fracture mechanics, reliability of mechanical engineering systems, biomechanics, kinematics, dynamics, stability, systems analysis, controls, computer simulation, thermal pollution, thermal stress analysis, solar energy, wind generated power.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test; B.S. degree in mechanical engineering, applied mechanics, or aerospace engineering or in a related field such as engineering science, civil engineering, applied physics, applied mathematics.

Program requirements: thesis, two advanced-level courses in mathematics (or one in mathematics and one in computer science), one course outside area of specialization. Almost all specilizations require use of digital computer techniques.

DOCTOR OF PHILOSOPHY

Admission requirements: master's degree and GRE with advanced test.

Program requirements: two advanced-level courses beyond M.S. in mathematics or computer science, one course outside area of specilization; research tool or associated studies in two areas. Almost all specializations require use of digital computer techniques.

MEDICINAL CHEMISTRY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Bond, *chairman.* Professor Smith; Associate Professors Abushanab, Turcotte; Adjunct Professor Modest.

SPECIALIZATIONS

Design and synthesis of potential medicinal agents, including antihypertensives, steroids, antimetabolites, antitumor agents, complex lipids, and molluscicides; development of methods of drugs analysis; drug instabilities.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test in chemistry, and bachelor's degree in pharmacy, chemistry, or allied sciences. TOEFL, minimum total score of 500, for foreign students.

Program requirements: thesis; physical chemistry and CHM 421, 425; MCH 443, 444, or equivalent; MCH 621, 622; one modern foreign language recommended.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE, including advanced test in chemistry, and master's degree in pharmacy, chemistry, or allied sciences or bachelor's degree in one of these with evidence of superior ability. TOEFL, minimum total score of 500, for foreign students.

Program requirements: reading knowledge of scientific German; CHM 522; MCH 621, 622; primary emphasis in organic and medicinal chemistry or pharmaceutical analysis, and secondary emphasis in related areas, e.g., physical chemistry, biochemistry, pharmacology, physical pharmacy, or pharmacognosy.

MICROBIOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor N. P. Wood, *chairman*. Professors Carpenter, Fisher, Houston, Sieburth, Traxler; Associate Professor Cohen; Assistant Professors Laux, Shivvers; Lecturer Hufnagel; Adjunct Professor Cabelli; Adjunct Associate Professor Prager.

SPECIALIZATIONS

Diagnostic and pathogenic bacteriology, waterborne pathogens; immunology, tumors and the immune response, cytophilic antibody; microbial genetics, transcriptional and translational control; microbial ecology, thermal pollution, bioassay and removal of pollutants, cell interaction and contact inhibition, marine ecosystem and mini-population development, soil conversion, marine algal nutrition, hydrocarbon and nitroaromatics degradation, halogenated compound cooxidation; industrial microbiology, protozoology, microtubule development, electron microscopy of cell structures and virus infected cells; microbial physiology, polyamine metabolism, redox controlled reactions; molecular biology, ribosome structure; food and sanitary microbiology, shellfish pollution.

MASTER OF SCIENCE

Admission requirements: GRE and two semesters each of introductory courses in biology (zoology, botany), inorganic and organic chemistry, mathematics, and physics; a semester each of microbiology, genetics, quantitative analysis, and biochemistry.

Program requirements: thesis; BCH 581; MIC 401, 599, 695, and 696; major portion of courses in microbiology, including one from an area other than bacteriology (virology, mycology, phycology, protozoology).

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree and two semesters of calculus and proficiency in one modern foreign language. Master's degree normally required; outstanding candidates may be accepted without an M.S. degree.

Program requirements: dissertation; BCH 581, 582; BPH 435, 521; MIC 401, 533, 541, 552, 621, 695, 696; two courses in microbiology from an area other than bacteriology (virology, mycology, phycology or protozoology); statistics. Of the credits earned beyond the master's degree, 18 should be in course work. Prior to the last semester, the candidate must pass written and oral comprehensive examinations in five areas of microbiology: pathogenic bacteriology, virology and immunology; microbial physiology; microbial genetics; ecology, food and determinative bacteriology; general microbiology.

NUCLEAR ENGINEERING

M.S.

GRADUATE FACULTY

Assistant Professor Knickle, *program coordinator*. Professors Mairs, Madsen; Associate Professor Rose; Adjunct Associate Professor DiMeglio; Adjunct Assistant Professor Doyle.

The program in nuclear engineering is administered by the Department of Chemical Engineering.

SPECIALIZATIONS

Boiling heat transfer, computational methods of reactor design, fluid dynamics, heat transfer, ion exchange, mass transfer, metallurgy, nuclear technology, power plant siting and economics, reactor design and evaluation, spectrometry.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in engineering, physics, or mathematics.

Program requirements: thesis and at least 12 credits in nuclear engineering with other subjects chosen from mathematics, physics, chemistry, and other branches of engineering.

NURSING

M.S.

GRADUATE FACULTY

Professor Tate, *dean*. Professor Cumings; Associate Professors Hirsch, Kang.

SPECIALIZATIONS

General nursing with teaching or administration.

MASTER OF SCIENCE

Admission requirements: MAT and a bachelor's degree from an NLN-accredited program with an upper division major in nursing.

Program requirements: 36 credit hours without thesis, including 21 credits in nursing which includes practicum, 3 credits in biological science, 6 credits in behavioral science, 6 elective credits related to functional area.

OCEAN ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Sheets, *chairman.* Professors Haas, Mitdleton, Nacci, Schenck, White; Associate Professors Kowalski, Rose; Assistant Professors Heidersbach, LeBlanc, Spaulding; Adjunct Associate Professor Moffet; Adjunct Assistant Professor DiNapoli.

SPECIALIZATIONS

Desalination of sea water, nuclear energy applications, corrosion, physical porperties of marine sediments, acoustic properties of sediments, finite amplitude acoustics, in-situ sediment measurements, sediment transport, coring techniques, bottom profiling and penetration; coastal and underwater structures, estuarine pollution, pollution abatement, waste disposal, turbidity measurements, mathematical modeling of estuaries; underwater acoustics, applications of information theory to underwater communications and data acquisition, turbulent boundary layer flow noise, underwater construction, guidance and control of underwater vehicles, digital processing of wave, current, and thermistor data; dynamics of towed body shapes, design of undersea pressure vessels, inelastic behavior of buoyant materials, wave motion and current studies, drag reduction with polymer additives, buoy dynamics, scuba safety and work effectiveness, underwater tooling, hydrodynamics of floating and submerged bodies.

MASTER OF SCIENCE

Admission requirements: GRE and B.S. degree in any conventional engineering field, mathematics, physics or equivalent; courses in thermodynamics, fluid flow.

Program requirements: thesis and three courses selected from OCE 512, 521, 534, 560, 565, 571, 587, 610, 653; one course selected from OCG 501, 521, 540, 561; and at least 12 course credits of electives.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and M.S. degree and master's thesis in engineering, physics or equivalent; ocean engineering and oceanography core courses, as in master of science program. Requirements must have been taken previously or will have to be made up for no program credit.

Program requirements: dissertation; one advanced applied mathematics course; completion of 30 course credits beyond master's.

SPECIAL FINANCIAL AID

Link Foundation fellowship for M.S. candidate; a limited number of graduate and research assistantships are available for highly qualified students.

OCEANOGRAPHY

M.S., Ph.D.

GRADUATE FACULTY

Professor Knauss, *provost,* Marine Affairs, and *dean,* Graduate School of Oceanography; Associate Professor Napora, *assistant dean for students.* Professors Dietz, Duce, Jeffries, Kennett, Marshall, McMaster, Pratt, Saila, Schilling, Sieburth, Smayda, Stern, Watkins, Winn; Associate Professors Hargraves, Kester, Lambert, Pilson, Quinn, Sastry, Sigurddson, Swift; Assistant Professors Bender, Nixon, Richardson; Adjunct Professors deBoer, Eisler, Holt, Kenyon, Krause, Phelps, Schneider, Shaw, Shonting, Sturges; Lecturer Oviatt.

SPECIALIZATIONS

Biological, chemical, geological, and physical oceanography.

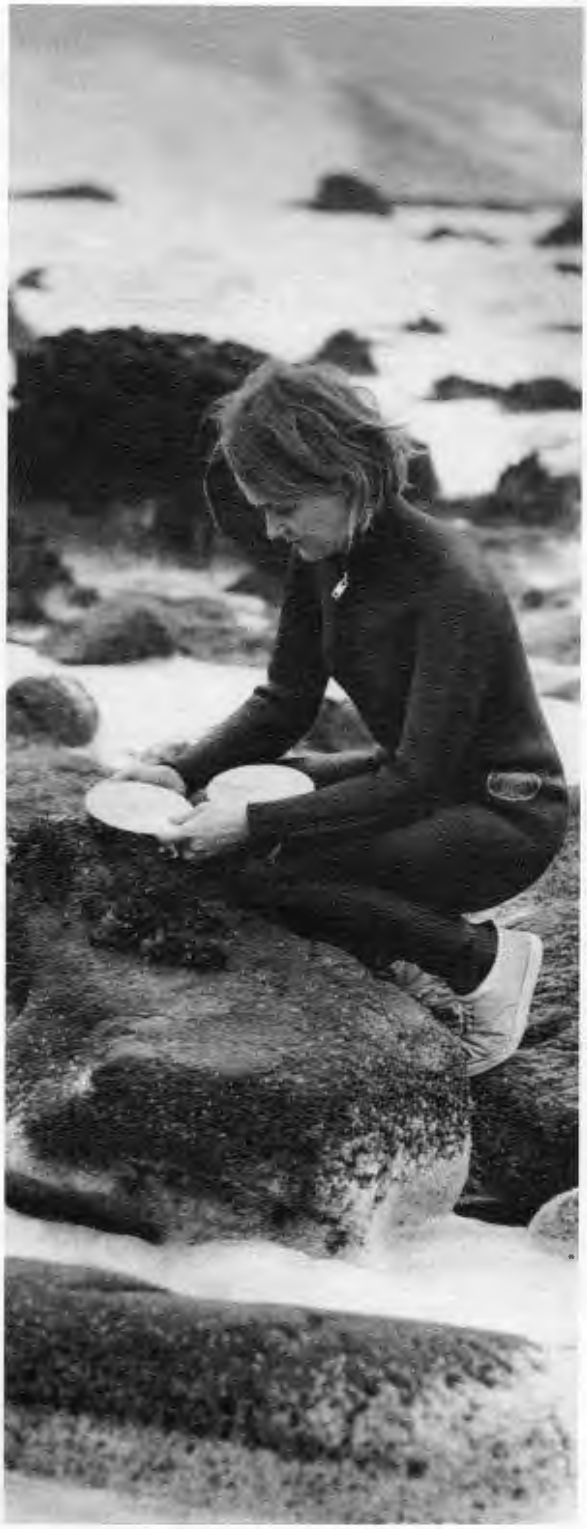
MASTER OF SCIENCE

Admission requirements: GRE (verbal, quantitative and advanced sections) and bachelor's degree (B average) in some field of the natural sciences or engineering. Applicants are admitted for September only. Due to the limited number of students that can be accepted as degree candidates, no application will be considered showing an undergraduate average of less than B unless there is post-baccalaureate work indicating outstanding ability. Applications should be completed by February 15.

Program requirements: thesis; OCG 501, 521, 540, 561, 695; participation in a regular ocean research cruise.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE (verbal, quantitative and advanced sections); master's degree is not re-



quired, but bachelor's degree (B average) in some field of natural sciences or engineering. Applicants are admitted for September only. Due to the limited number of students that can be accepted as degree candidates, no application will be considered showing an undergraduate average of less than B unless there is post-baccalaureate work indicating outstanding ability. Applications should be completed by February 15.

Program requirements: B grade in core courses, OCG 501, 521, 540, 561; six additional course credits in oceanography at the 600 level (excluding problems and research courses and OCG 695); participation in regular ocean research cruise. Although there is no general language requirement, the individual student's major professor may require him to demonstrate ability in one or more foreign languages.

SPECIAL FINANCIAL AID

There is a limited number of research assistantships and traineeships for master's and doctoral candidates.

PHARMACOGNOSY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Worthen, *chairman.* Professor Youngken; Associate Professor Shimizu; Assistant Professor Lyon.

SPECIALIZATIONS

Biosynthesis of drug plant constituents, natural product chemistry including the isolation and structural elucidation of materials of potential medicinal interest, screening of natural products for physiologically-active agents including materials from both land and marine sources.

MASTER OF SCIENCE

Admission requirements: GRE, bachelor's degree in pharmacy, chemistry or biology.

Program requirements: thesis; PCG 445, 446, 447, or equivalent; PCG 548, PCL 441, 442, or equivalent; CHM 425; BOT 445.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE and master's degree in pharmacy, chemistry or biology, or bachelor's de-

gree in one of these with evidence of superior ability.

Program requirements: PCG 551, 552, 633, 634. A candidate entering the Ph.D. program with a bachelor's degree must also meet the M.S. program requirements.

PHARMACOLOGY AND TOXICOLOGY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor DeFeo, *chairman*. Professors Lal, DeFanti; Associate Professors Carlson, Fuller; Assistant Professor Swonger; Adjunct Professors Cardinale, Karkalas, Pogacar.

SPECIALIZATIONS

Behavioral, biochemical, cardiovascular, environmental, and marine pharmacology; toxicology; forensic toxicology.

MASTER OF SCIENCE

Admission requirements: GRE or MAT, and bachelor's degree with science major.

Program requirements: thesis; mathematics through calculus; physical chemistry; one course in statistics; principles of pharmacology; PCL 441, 442, 521, 522. Other courses and research training will be included to complete the program, in accordance with the student's interest and background.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE or MAT, and bachelor's or master's degree with science major.

Program requirements: M.S. degree must be earned prior to Ph.D. if admission is granted without it. Additional courses and special training included according to the requirements of each student's program. Independent research topics will be selected in accordance with the student's interests.

PHARMACY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Ballard, *chairman*. Professors Osborne, Paruta; Assistant Professors Cooper, Fish, Lausier; Clinical Professor Jeffrey; Clinical Associate Professor Gallina; Clinical Assistant Professor Pinkus.

SPECIALIZATIONS

Physical pharmacy, manufacturing and formulation of pharmaceuticals, quality control, biopharmaceutics, hospital pharmacy, clinical pharmacy.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in pharmacy or equivalent.

Program requirements: thesis, PHC 521, 522, one modern foreign language strongly recommended.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: same as for master's degree.

Program requirements: PHC 521, 522.

PHARMACY ADMINISTRATION

M.S.

GRADUATE FACULTY

Associate Professor Campbell, *chairman*. Associate Professors Crombe, Jacoff; Assistant Professor McKercher; Special Lecturer Hachadorian.

SPECIALIZATIONS

Development and utilization of pharmacy resources in health care systems involving the organization, financing, and delivery of health care services and materials.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and bachelor's degree in pharmacy, social sciences, or allied fields.

Program requirements: thesis; PAD 599, 621, 622.

SPECIAL FINANCIAL AID

Fellowships from the American Foundation for Pharmaceutical Education.

PHILOSOPHY

M.A.

GRADUATE FACULTY

Associate Professor Wenisch, *acting chairman*. Professors Freeman, Young; Associate Professors Kim,

Schwarz; Assistant Professors Fedoryka, Hanke, Kowalski, Peterson, Zeyl.

SPECIALIZATIONS

History of philosophy, philosophical logic, philosophy of religion, epistemology, metaphysics, Munich School of Phenomenology.

MASTER OF ARTS

Admission requirements: GRE.

Program requirements: thesis, comprehensive examination and a language, French or German preferred.

PHYSICAL EDUCATION

M.S.

The graduate program in physical education is open to both men and women.

GRADUATE FACULTY

Associate Professor Nedwidek, *coordinator;* Associate Professor Zarchen, *chairman,* Physical Education for Men; Professor Massey, *chairman,* Physical Education for Women. Professor Slader; Associate Professors Crooker, Leathers, Mandell, Sonstroem; Assistant Professors Bloomquist, Cohen, DelSanto, McCormick, O'Donnell, Polidoro, Sherman.

SPECIALIZATIONS

Health education, recreation education, physical education for mentally retarded, and psychology of sport.

MASTER OF SCIENCE

Admission requirements: MAT or GRE with B.S. degree in physical education, health and physical education, or health education. In exceptional cases, a candidate without a physical education major, but with a strong emphasis in physical education, is accepted.

Program requirements: thesis (30 credit hours) and PED 510, 530, 520; for non-thesis option (33 credit hours), PED 510, 530, 520, and 591. Non-thesis option requires a written comprehensive examination.

PHYSICS

M.S., Ph.D.

GRADUATE FACULTY

Professor Pickart, *chairman.* Professors Dietz, Malik, Quirk; Associate Professors Choudry, Desjardins, Hartt, Kaufman, Letcher; Assistant Professors Cuomo, Kirwan, Northby.

The department offers courses leading to the degrees of Master of Science (with or without thesis) and Doctor of Philosophy. At the doctoral level, research is concentrated in the areas of neutron physics and liquid state physics. Neutron scattering, diffraction, and radiational experiments are carried out at the Rhode Island Nuclear Science Center at the Narragansett Bay Campus and in conjunction with Brookhaven National Laboratory.

Liquid state research includes studies of physical acoustics, underwater acoustics, infrared spectroscopy, Brillouin scattering, and liquid helium studies. The department has a 16-inch reflecting optical telescope developed for photography and dual-channel photometry. Theoretical research areas include nuclear and particle physics.

SPECIALIZATIONS

Neutron diffraction and scattering, hypernuclear physics, ultrasonic studies in liquid crystals and metals, underwater propagation of acoustic waves, infrared spectrophotometry, propagation of waves in stochastic media, Brillouin scattering, liquid helium, few nucleon systematics, computational physics, color centers, radiation effects in solids.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test and bachelor's degree with major in physics preferred.

Program requirements: thesis and PHY 520, 530, 570, 580. For non-thesis option, the student shall complete 36 course credits, with at least one course requiring a substantial paper involving significant independent study. Twelve of the course credits shall be in the 500- or 600-level physics courses that are in addition to those core courses required of all master's degree candidates. The non-thesis student shall successfully complete a final oral examination that will not exceed one and one-half hours in length.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE with advanced test and bachelor's degree with major in physics preferred. Master's degree is not required.

Program requirements: PHY 510, 511, 520, 530, 531, 570, 571, 580, 620, 650, 660 and either 651 or 661. There is no formal departmental language requirements; however, the candidate's committee may require language proficiency.

PLANT AND SOIL SCIENCE

M.S.

GRADUATE FACULTY

Professor Larmie, *chairman*. Professors Shutak, Skogley, Stuckey, Wakefield; Associate Professors Brown, Gould, Griffiths, Hindle, Hull, McGuire; Assistant Professors Duff, Golet, Jagschitz, Shaw, Wright.

Work beyond the M.S. degree in plant and soil science may be developed in cooperation with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS

Emphasis on one or more of the following plant commodities: turfgrasses, woody ornamentals, flowers, fruits, vegetables, and field crops. Specific programs may feature one or more of the following: soil-plant-climate relationships, soil science and land use, physiology, post-harvest physiology, propagation, ecology, weed science and plant breeding. Work with radioisotopes, growth regulators and mineral nutrients is considered basic. Plant associations such as exist in the home landscape, along roadsides, and in salt marshlands are suitable for ecological study.

MASTER OF SCIENCE

Admission requirements: GRE and an undergraduate major in agronomy, horticulture, botany, soil science-plant science, or any of the natural sciences.

Program requirements: thesis and background study in plant and soil science, botany, chemistry and statistics.

PLANT PATHOLOGY-ENTOMOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Traxler, *chairman*. Professors Beckman, Kerr, Mueller; Associate Professor Jackson; Assistant Professors Englander, Field; Adjunct Professors Kaplan, Tarzwell.

SPECIALIZATIONS

Plant Pathology: disease resistance mechanisms, fine structure of pathogen-host interactions, epidemiology of turfgrass diseases, epidemiology of woody ornamental diseases. *Entomology:* economic entomology. *Biodegradation:* microbial degradation of nitro-aromatic compounds, psychrophilic metabolism of hydrocarbons by bacteria, bacterial cooxidation of halogenated aromatic compounds.

MASTER OF SCIENCE

Admission requirements: GRE with undergraduate major in biological, agricultural or physical sciences. Applications should be completed by March 15.

Program requirements: thesis and seminars.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Limited to Plant Pathology and Biodegradation specializations.

Admission requirements: GRE and bachelor's or master's degree in biological, argricultural or physical sciences. Applications should be completed by March 15.

Program requirements: dissertation and participation in seminars.

POLITICAL SCIENCE

M.A., M.P.A.

GRADUATE FACULTY

Associate Professor Leduc, *chairman*. Professors Stein, Warren, Wood, Zucker; Associate Professors Killilea, Milburn; Assistant Professors Grossbard, Tyler

SPECIALIZATIONS

American government, international relations, politics of the developing areas, urban affairs, comparative governments, public administration.

MASTER OF ARTS AND MASTER OF PUBLIC ADMINISTRATION

Admission requirements: GRE with undergraduate credit in basic political science and political theory.

Program requirements: thesis and non-thesis option; PSC 553. Non-thesis option for M.A. degree requires oral examination in addition to comprehensives. Internship program required for M.P.A.

Interdisciplinary programs involving 15-18 additional credits in associated fields lead to graduate certificates in North Atlantic Regional Studies and in International Development awarded by the Dean of the Graduate School as adjuncts to the M.A. in political science. See International Studies.

PSYCHOLOGY

M.S., Ph.D.

GRADUATE FACULTY

Associate Professor Berman, *acting chairman.*

Full-time: Professors Berger, A. J. Lott, Merenda, Silverstein, Vosburgh, Willoughby; Associate Professors Biller, Cain, Grebstein, Gross, Prochaska, Smith; Assistant Professors Berk, Makokian, O'Keefe, Stevenson, Valentino, Velicer.

Part-time: Professor Archer; Associate Professor B. Lott; Clinical Professors Mohrnheim, Redmon; Clinical Associate Professors Karkalas, Nicotra, Richardson, Silverman.

SPECIALIZATIONS

Clinical, general-experimental and school psychology; neuropsychology, verbal learning, psychotherapeutic models and outcome, clinical psychodiagnosis, clinical-child, measurement, community practices, personality and rehabilitation, alcoholism, exceptional child, aversive conditioning, behavioral modification techniques, learning disabilities, social learning. Specialization in psychopharmacology is interdepartmental with the Department of Pharmacology.

MASTER OF SCIENCE (school psychology only)

Admission requirements: MAT and GRE with advanced test; undergraduate major in psychology recommended. Applicants are admitted for September only. Applications must be completed by February 15.

Program requirements: non-thesis (45 to 54 credits); one semester internship.

DOCTOR OF PHILOSOPHY (clinical, general-experimental and school psychology)

Admission requirements: MAT and GRE with advanced test; evidence of research competency. Applicants are admitted for September only. Applications must be completed by February 15. Prospective applicants are asked to address initial inquiries concerning the desired specialization to the department, but formal application materials must be obtained from and returned directly to the Graduate School Office. Applicants to clinical program having postbaccalaureate experience are given special consideration.

Due to limited facilities, new admissions to the doctoral programs in clinical and school psychology must be limited to a small number per year. Although test scores and cumulative averages are not the sole criteria for admission, those with overall quality point averages of less than 3.0 on a 4.0 scale, or with GRE or MAT scores below the 50th percentile (using psychology norms for the MAT) are advised that there is little chance for admission to these programs where so few of those with better academic qualifications can be accommodated.

Program requirements: academic core of 18 credits is required for all Ph.D. programs in psychology (emphasis in clinical, school or general-experimental). The core includes developmental, social personality, learning, cognitive perceptual processes, physiology, and 6 credits in research design. Students in clinical psychology may choose to elect an alternate track, leading to the Ph.D. in clinical psychology. The core for this track includes just the 6 credits in research design, with the remaining credits in electives. Students in all programs are required to have a minimum of 18 research credits. Additional requirements are required by specific program areas. Demonstration of research competency, through a master's thesis or equivalent research project, is required.

The clinical psychology doctor of philosophy program is provisionally accredited by the American Psychological Assocation.

RESOURCE ECONOMICS

M.S.

GRADUATE FACULTY

Professor Cummings, *chairman.* Professors Holmsen, Lampe, Norton, Rorholm, Spaulding; Associate Pro-

fessor Wallace; Assistant Professors Gates, Grigalunas, Hueth, McConnell, McFarland, Seay, Weaver.

SPECIALIZATIONS

Econometrics, mathematical economics and resource economics, marine economics, market and price analysis, production economics.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and bachelor's degree with strong background in the social sciences, statistics, or mathematics.

Program requirements: 24 credit hours plus thesis.

SOCIOLOGY

M.A.

GRADUATE FACULTY

Associate Professor Poggie, *chairman.* Professors England, Rosengren, Spaulding; Associate Professors Bouvier, Gardner, Gersuny; Assistant Professors Bassis, Gelles, Hodges, Loy, Lynch, Pollnac, Reilly, Sennott, Travisano, Turnbaugh; Instructors Carroll, Guthrie.

SPECIALIZATIONS

Population and demography, race relations, medical sociology, criminology, resource development, culture and personality, complex organizations, sociology of education, deviance.

MASTER OF ARTS

Admission requirements: MAT (preferred) or GRE including advanced sociology; strong background in social sciences. B.A. degree in sociology preferred.

Program requirements: for thesis program, 24 credits comprised of at least six 500-level courses, including SOC 502, 505, 506; at least two other 500-level sociology courses; thesis; familiarity with theory and methods sections of the department's M.A. reading list; oral examination on that literature and on thesis. For non-thesis program: 30 credits comprised of at least seven 500-level courses, including SOC 502, 505, 506; at least three other 500-level sociology courses; familiarity with theory and methods sections of the reading list plus two additional sections; written and oral comprehensive examinations based on that literature.

SPANISH

M.A.

GRADUATE FACULTY

Professor Capasso, *chairman,* Department of Languages; Professor Hutton, *section head.* Professor Kossoff; Assistant Professors Freedman, Navascués.

SPECIALIZATIONS

Spanish literature or the literature of the Spanish-speaking world.

MASTER OF ARTS

Admission requirements: MAT or GRE; undergraduate major in Spanish or equivalent, including 12 credits in Spanish or Hispanic-American literature. Qualifed students may be admitted with less than 12 credits but must make them up without graduate credit.

Program requirements: all work carried out in Spanish. For thesis option, SPA 591, seven courses (21 credits), and thesis (6 credits). For non-thesis option, SPA 591, and nine courses (27 credits).

SPEECH PATHOLOGY AND AUDIOLOGY

M.A., M.S.

GRADUATE FACULTY

Assistant Professor Grubman, *director of graduate programs.* Professors Beaupre, FitzSimons; Associate Professor Bailey; Assistant Professors Arnst, Jirsa; Clinical Assistant Professor Regan; Clinical Supervisor Finck.

SPECIALIZATIONS

Audiology and speech pathology.

MASTER OF ARTS AND MASTER OF SCIENCE

Admission requirements: MAT or GRE; 24 undergraduate credit hours in general speech, speech science, speech development, language development, child development, psychology, or education.

Program requirements: for M.A. in speech pathology (39 credit hours), thesis, SPE 504, 24 credit hours in speech pathology, 6 credit hours in audiology. *For M.A. in audiology* (39 credit hours), thesis, SPE 504, 24 credit hours in audiology, 6 credit

hours in speech pathology. *For M.S. in speech pathology* (39 credit hours), no thesis; written and oral comprehensive examinations; SPE 504, 30 credit hours in speech pathology and 6 credit hours in audiology. *For M.S. in audiology* (39 credit hours), no thesis; written and oral comprehensive examinations; SPE 504, 30 credit hours in audiology and 6 credit hours in speech pathology. For either the M.A. or M.S. programs in speech pathology or audiology, students must complete a minimum of 300 supervised clock hours of practicum in addition to the academic requirements. Because program requirements in both speech pathology and audiology include academic as well as clinical responsibilities, the average length of time to complete any of the programs is two academic years. Completed applications for either the summer or fall semester must be received no later than March 1. Applications for the spring semester are not encouraged; however, under special circumstances they will be considered if the completed applications are received no later than November 1.

TEXTILES, CLOTHING AND RELATED ART

M.S.

GRADUATE FACULTY

Professor V. V. Carpenter, *chairman*. Professor Fry; Assistant Professors Darling, Gilbert, Weeden.

SPECIALIZATIONS

Social science aspect of textiles and clothing, physical science aspect of textiles and clothing, historic textiles and costume.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and undergraduate degree in textiles and clothing, social science or allied fields.

Program requirements: thesis or non-thesis option, 30 credits. For thesis option, TXC 524, 580; courses in statistics recommended. For non-thesis option, TXC 524, 550, 560, 570.

ZOOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Harrison, *acting chairman*. Professors Chipman, Hammen, Hyland, Saila, Shoop, Winn; Associate Professors Costantino, Goertemiller, Heppner, Hill, Krueger, Mathewson, Mottinger; Assistant Professors Bibb, Cobb, Kass-Simon, Surver; Adjunct Professors Bass, Carriker, Dowling, Gibbs, Schaefer.

SPECIALIZATIONS

Acarology, animal behavior, cytology, ecology, embryology, entomology, fisheries biology, genetics, herpetology, histology, ichthyology, invertebrate zoology, limnology, mammalogy, ornithology, parasitology, physiological ecology, physiology, radioecology, reproductive biology, taxonomy.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test (biology) and bachelor's degree with major in zoology, biology or allied field. Applicants are normally admitted for September only. Applications should be completed by February 15.

Program requirements: thesis; ZOO 595, 596.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree is not required. GRE with advanced test (biology) and bachelor's degree with major in zoology, biology or allied field.

Program requirements: dissertation, two languages (one of which may be substituted with faculty approval), ZOO 595, 596.

Courses of Instruction

F = Fall 74 (as of 12/05/74 enrollment figures)
S = Spring 75 (as of 5/ 75 enrollments)

All graduate-level courses are described in full on the following pages. Undergraduate courses numbered at the 400 level, permitted for graduate credit in some cases, are described in the *Undergraduate Bulletin* and are listed here for reference only. Courses at the 500 level comprise the majority of course work between the bachelor's and the master's degrees. Those at the 600 level are advanced graduate courses. The 900 level courses are special types of graduate courses including graduate courses for which no degree credit is given. They include courses offered to remedy deficiencies as well as workshops, institutes, and courses offered one time only by visiting faculty.

Courses with two numbers, e.g. APA 501, 502, indicate a year's sequence and the first course is either a prerequisite for the second or at least the two cannot be taken in reverse order without special permission. Parentheses after a course number enclose either the old course number, or in cases of multiple listings, the departments and numbers under which the course is also offered.

The roman numeral indicates the semester the course will normally be offered; some courses, however, are offered only in alternate years and a few less frequently. The *Schedule of Courses* issued by the registrar at the November and May registration period must therefore be consulted to determine which courses will be offered in the following semester. The arabic numeral indicates the credit hours; distribution of class hours each week is in parentheses. The instructor's name follows the course description.

ACCOUNTING (ACC)

413 Contemporary Accounting Issues *I, 3*

415 Accounting-Computer Systems *I, 3*

422 Advanced Cost Accounting *II, 3*

F **431 Advanced Accounting** *II, 3*

F **443 Federal Tax Accounting** *I, 3*

444 Topics in Federal Taxation *II, 3*

461 Auditing *II, 3*

F S **510 Financial Accounting** *I and II, 3*
Concepts of financial accounting in the analysis and interpretation of financial statements; emphasis on accounting principles. *(Lec. 3)* Staff

F 13 **513 Accounting Systems** *I, 3*
Principles and problems related to design and installation of accounting control systems with emphasis on automated data processing. *(Lec. 3) Prerequisite: ACC 312 or permission of department.* Staff

S **535 Advanced Problems in Accounting** *II, 3*
General and specialized accounting problems that constitute the subject matter of CPA examinations. *(Lec. 3) Prerequisite: ACC 431.* Staff

S 14 **548 Accounting for Non-Commercial Entities** *II, 3*
Principles and practices of fund accounting as applied to municipalities, educational institutions, hospitals and similar organizations, with particular emphasis upon municipal records and statements. *(Lec. 3) Prerequisite: permission of instructor.* Staff

611 Managerial Accounting *I and II, 3*
Determination of accounting information for the purposes of decision making, control, and evaluation with emphasis on decision models using accounting information. *(Lec. 3) Prerequisite: ACC 510.* Brandon, duBois, Martin

618 Current Accounting Theory *I, 3*
Critical examination of accounting theory and practice to develop research techniques with emphasis on financial accounting. *(Lec. 3) Prerequisite: ACC 510.* Brandon

619 Current Accounting Theory *II, 3*
Critical examination of accounting theory and practice to develop research techniques with emphasis on managerial accounting. *(Lec. 3) Prerequisite: ACC 321 or 611.* Vangermeersch

662 Advanced Auditing *II, 3*
Statements on auditing standards, auditing electronic systems, auditor's reports, statistical sampling in auditing, regulations of SEC, and cases in auditing. *(Lec. 3) Prerequisite: MGS 581, ACC 461.* Brandon

ANIMAL PATHOLOGY (APA)

401 Introduction to Pathology *I or II, 3*

422 Avian Diseases *II, 3*

461 Laboratory Animal Technology *I, 3*

501, 502 Seminar *I and II, 1 each*
Preparation and presentation of scientific papers on selected subjects in animal pathology and virology. Staff

534 Animal Virology *II, 3*
Basic properties, classification and evolution of animal viruses. Individual agents are studied in detail. *(Lec. 3) Prequisite: MIC 432, 533 and permission of department.* Yates and Chang

536 Virology Laboratory *II, 2*
Methods employed in diagnosis and for the investigation of the biological, physical, and chemical properties of animal viruses. *(Lab. 6) Prerequisite: APA 534. (May be taken simultaneously.)* Yates and Chang.

538 Epidemiology of Viral and Rickettsial Diseases *II, 2*
Principles of epidemiology. Interrelationships of host, environment and agent in viral and rickettsial diseases. *(Lec. 2) Prerequisite: APA 534. (May be taken simultaneously.) In alternate years, next offered 1975-76.* Chang

591, 592 Special Projects *I and II, 1-3 each*
Research projects in animal pathology and virology. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ANIMAL SCIENCE (ASC)

412 Animal Nutrition *II, 3*

415 Physiology of Lactation *I, 3*

432 Biology of the Fowl *II, 3*

441 Food Analysis *I, 3*

442 Animal Breeding *II, 3*

444 Food Quality *II, 3*

461 Laboratory Animal Technology *I, 3*

470 Population Genetics *II, 3*

472 Physiology of Reproduction *II, 3*

491, 492 Special Projects *I and II, 1-3 each*

501, 502 (401, 402) Animal Science Seminar *I and II, 1 each*
Preparation and presentation of papers on recent scientific developments and selected subjects in animal and poultry science and food science. *(Lec. 1) Prerequisite: senior standing.* Staff

512 Advanced Animal Nutrition *II, 3*
Digestion and metabolism of protein, carbohydrate, and fat by ruminant and nonruminant animals. Role of vitamins and minerals in metabolism. Experimental methods in animal nutrition. Empasis on the ruminant animal. *(Lec. 2, Lab. 2) Prerequisite: ASC 412, CHM 124 or BCH 581 and permission of department. In alternate years, next offered 1975-76.* Hinkson

532 Experimental Design
See Experimental Statistics 532.

591, 592 Research Problems *I and II, 3 each*
Research problems to meet individual needs of graduate and honors students in the fields of animal breeding, nutrition, or physiology and food science. *(Lab. 6, TBA) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor program committee.

Note: for Biochemistry of Foods, see FRC 431, 432.

ANTHROPOLOGY (APG)

401 History of Anthropological Theory *I or II, 3*

402 Methods of Anthropological Inquiry *I or II, 3*

405 Psychological Anthropology *I or II, 3*

407 Economic Anthropology *I or II, 3*

409 Anthropological Linguistics *I or II, 3*

470 Problems in Anthropology *I and II, 3*

ART (ART)

403, 404 Studio—Seminar I and II *I and II, 3-6 each*

405, 406 Studio—Seminar III and IV *I and II, 3-6 each*

462 Modern Art Seminar: Art since 1945 *II, 3*

469, 470 Art History—Senior Projects *I and II, 3-6 each*

501 Graduate Studio—Seminar I *I and II, 3-12*
Intensive independent studio work under the guidance of appropriate advisers. Periodic critiques and discussions related to work of all participants in the course. *(Studio 6-24) Prerequisite: permission of department.* Staff.

502 Graduate Studio—Seminar II *I and II, 3-12*
Continuation of ART 501. *(Studio 6-24) Prerequisite: permission of department.* Staff

ASTRONOMY (AST)

408 Introduction to Astrophysics *II, 3*

BIOCHEMISTRY (BCH)

400 Chemistry and Biochemistry of Carbohydrates *II, 3*

411 Biochemistry Laboratory *II, 3*

531, 532, 533, 534 Seminar in Biochemistry *I and II, 1 each*
Presentation of a seminar on selected topics in contemporary biochemistry. *(Lec. 1) Prerequisite: permission of department.* Staff

541, 542 Laboratory Techniques in Biochemistry *I and II, 3 each*
Biochemical techniques of enzyme preparation and purification, cell fractionation, ion-exchange and paper chromatography, manometry, fluorometry, polarography, radioactive tracer. Assigned research on advanced level using techniques. *(Lab. 9) Prerequisite: permission of department.* Purvis and Dain

581, 582 General Biochemistry *I and II, 3 each*
Systematic treatment of the principles of biochemistry. Basic course dealing with chemistry of biological substances and transformations in living organisms. *(Lec. 3) Prerequisite: CHM 221, 222.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601 Enzymes *I, 3*
Factors affecting the rate of catalysis in enzymic reactions. Thermodynamic and kinetic characteristic of enzymes' profiles. *(Lec. 1 1/2, Lab. 8) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1975-76.* Purvis and Tremblay

602 The Mitochondrion *II, 3*
Detailed study of the structure, properties and functions of the mitochondrion. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1975-76.* Purvis

611 Intermediary Metabolism *I, 3*
Intensive study of metabolic pathways of carbohydrates, lipids and nitrogenous compounds, their interrelationships. Effects of hormonal and nutritional status on activity of these pathways. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years.* Purvis and Tremblay

612 Biochemical Regulation of Cellular Metabolism *II, 3*
Biochemical regulatory mechanisms of cellular metabolism in micro-organisms and mammalian systems, at the level of the genome, protein synthesis and enzyme catalysis. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years.* Tremblay

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BIOPHYSICS (BPH)

401 Quantitative Cell Culture *I, 3*

403 Introduction to Electron Microscopy *I, 2*

405 Electron Microscopy Laboratory *I, 2*

521 Introductory Biophysics *I, 3*
Use of viscosity, diffusion, ultracentrifugation, light scattering, spectrophotometry and X-ray diffraction to study the size, shape, structure, and molecular weight of biological macromolecules. *(Lec. 3) Prerequisite: one year chemistry and one year biology.* Hartman

522 Intermediate Biophysics *II, 3*
Molecular structure, physical chemistry and genetics of viruses and nucleic acids. *(Lec. 3) Prerequisite: BPH 521. In alternate years, next offered 1975-76.* Hartman

523, 524 Special Topics in Biophysics *I and II, 1-6 each*
Advanced work arranged to suit the individual needs of the student. Lecture and/or laboratory according to the nature of the problem. Credits not to exceed a total of 12. *Prerequisite: permission of department.* Staff

526 Nuclear and Radiation Physics in Biology *II, 4*
Fundamental aspects of radioactivity; alpha and beta particles and gamma rays, radiation detection; application of tracer techniques to biological systems; interaction of high energy radiations with matter and with biological systems; health physics and disposal of radioactive wastes. *(Lec. 2, Lab. 6) Prerequisite: one year chemistry and one year biology, or permission of department. In alternate years, next offered 1975-76.* Fisher

595, 596 Seminar *I and II, 1 each*
Presentation of papers on selected subjects in biophysics. *(Lec. 1) Required of all graduate students in biophysics.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611 Advanced Biophysics *I, 3*
Physical and chemical properties of macromolecules in solution. *(Lec. 3) Prerequisite: BPH 521 or permission of department. In alternate years.* Fisher

622 Advanced Electron Microscopy *II, 2*
The physical functioning of electron microscopes; high resolution microscopy of macro-molecules; newly available EM histochemical procedures; and computer processing of electron images. *(Lec. 2) Prerequisite: BPH 403, 405 or permission of department.* Hufnagel

624 Advanced Electron Microscopy Laboratory *II, 2*
Cleaning and aligning the electron microscope; development of independent projects utilizing advanced techniques; and formal presentation of results of individual projects to the class. *(Lab. 6) Prerequisite: prior or concurrent registration in BPH 622 or permission of department.* Hufnagel

651, 652 Research in Biophysics *I and II, 3 each*
Student is required to outline a research problem, conduct necessary literature survey and experimental work and present his observations and conclusions in a report. *(Lab. 6) Prerequisite: graduate standing.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BOTANY (BOT)

402 Systematic Botany *I, 3*

417 Field Aquatic Plant Ecology *I, 3*

418 Marine Botany *II, 3*

419 Freshwater Botany *II, 3*

421 Advanced Practicum in Aquatic Plant Ecology *II, 3*

424 Plant Ecology *II, 3*

432 Mycology: Introduction to the Fungi *I, 4*

445 Advanced Plant Physiology *II, 3*

453 Cytology *I, 3*

455 Marine Ecology *I, 3*

457 Marine Ecology Laboratory *I, 1*

511 Developmental Plant Anatomy *II, 3*
Ontogeny of plant structures is studied from zygote through seed production with emphasis on recent experimental studies which elucidate the morphogenetic mechanisms. Ecological anatomy is included. *(Lec. 2, Lab. 3) Prerequisite: BOT 311 or equivalent. In alternate years, next offered 1974-75.* Hauke

512 Morphology of Vascular Plants *II, 3*
Comparative survey of development, form and anatomy of extinct and extant vascular plants and a modern interpretation of evidence concerning their interrelationships. *(Lec. 2, Lab. 2) Prerequisite: BOT 311 or equivalent. In alternate years.* Hauke

524 Methods in Plant Ecology *I, 3*
Methods in analysis of vegetation and microenvironments. Emphasis on quantitative techniques in analysis of vegetation, soil and microclimate, techniques in physiological ecology. *(Lec. 2, Lab. 2) Prerequisite: BOT 111 and 424 or equivalent; EST 411, 412 desirable. In alternate years.* Halvorson

526 (or GEG 526) Plant Geography *I, 3*
Environmental and non-environmental factors controlling distribution of species and vegetative types; origin,

development and senescence of floras; distribution of modern vegetation types and theories of modern-day species distribution. *(Lec. 2, Lab. 2) Prerequisite: BOT 402, 424, or permission of department. In alternate years, next offered 1975-76.* Halvorson

534 Physiology of the Fungi *I, 3*
Life processes of fungi with particular emphasis on chemical composition, organic and mineral nutrition, toxic and stimulating agencies, and metabolism. Also stresses phenomena of variation of growth and sporulation as affected by various environmental factors. *(Lec. 2, Lab. 2) Prerequisite: BOT 332, or permission of department. In alternate years, next offered 1975-76.* Caroselli

536 Phytopathological Technique *I, 3*
Research procedures in plant pathology including isolation and inoculation practices, maintenance of pathogenes, disease diagnosis. Techniques for determining fungi-toxic and phytotoxic properties of chemicals. Literature, methods for preparing manuscripts. *(Lec. 1, Lab. 4) Prerequisite: BOT 332 or permission of department. In alternate years.* Caroselli

540 Experimental Mycology *II, 3*
Growth and reproduction of fungi as affected by nutritional, environmental and genetic factors, with emphasis on experimental methods. *(Lec. 1, Lab. 4) Prerequisite: BOT 432 and MIC 201, or permission of instructor. In alternate years, next offered 1975-76.* Goos

542 Medical Mycology *II, 3*
Fungi pathogenic for man and animals. *(Lec. 2, Lab. 2) Prerequisite: BOT 432 or MIC 201, or permission of instructor.* Goos

551 Seminar in Aquatic Botany *I, 1*
Readings and discussion on current research involving algae and other aquatic plants. *(Lec. 1) Prerequisite: permission of instructor.* Harlin, Wood

554 Cytogenetics *I, 4*
Comparisons of various types of crossing-over, chromosomal aberrations and their effects, mutation and other cytogenetic phenomena in fungi and higher organisms. Laboratory studies of meiosis in maize, identification of chromosomes and induced rearrangements. *(Lec. 2, Lab. 4) Prerequisite: BOT 352, 453, or permission of instructor.* Mottinger

559 Physiological Ecology of Marine Macroalgae *I, 4*
Comparative studies designed to investigate those environmental factors regulating distribution, physiology and development of macroalgae through field, laboratory and library research. *(Lec. 2, Lab. 4) Prerequisite: BOT 416 or equivalent, or permission of instructor. In alternate years, next offered 1975-76.* Harlin

562 Seminar in Plant Ecology *II, 2*
Recent topics and investigations pertinent to plant ecology. Library research, oral presentation of reports, and group discussions. *(Lec. 2) Prerequisite: BOT 424 or equivalent, and permission of instructor.* Halvorson

579 Advanced Genetics Seminar
See Zoology 579.

581, 582 Botany Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to botany. *(Lec. 1) Prerequisite: required of graduate students majoring in botany. S/U credit.* Staff

591, 592 Botanical Problems *I and II, 1-3 each*
Special work arranged to meet the needs of individual students who are prepared for and desire advanced work in botany. Offered only by arrangement with staff. *(Lec. 1-3, Lab. 2-6)* Staff

593, 594 Botanical Problems *I and II, 1-3 each*
Similar to BOT 591, 592, but arranged to meet needs of students desiring further advanced work in botany. Offered only by arrangement with staff. *(Lec. 1-3, Lab. 2-6)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

616 The Biogeography of Marine Algae *II, 3*
Marine algae of the world, with consideration of the global distribution of taxa, geographic-ecologic ranges, and economic aspects. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor. In alternate years, next offered 1974-75.* Wood

640 Advanced Mycology Seminar *I and II, 1 each*
Specialized and advanced treatment of biology and research in the major groups of the fungi, including systematics, physiology, and ecology. *(Lec. 1) Prerequisite: permission of instructor. May be repeated.* Goos

645 Environmental Plant Physiology *I, 3*
Environmental parameters influencing growth and development of the cellular and organismic levels of organization through physiological control mechanisms. Emphasis on flowering plants. *(Lec. 3) Prerequisite: BOT 445, BCH 582 or FRC 452 or equivalent, or permission of instructor. In alternate years, next offered 1975-76.* Albert

659 Seminar in Physiological Ecology of Macroalgae *II, 1*
Readings and discussion of specialized and advanced research, stressing mechanism of environmental adaption. *(Lec. 1) Prerequisite: BOT 599, or permission of instructor.* Harlin

661 Phytoplankton Taxonomy
See Oceanography 661.

663 Phytoplankton Physiology
See Oceanography 663.

664 Phytoplankton Ecology
See Oceanography 664.

667, 668, 669 Advanced Phytoplankton Seminars
See Oceanography 667, 668, 669.

691, 692 Botanical Problems *I and II, 1-6 each*
Special work to meet needs of individual students who are prepared to undertake special problems. *(Lec. 3 or Lab. 6) Prerequisite: permission of department.* Staff

693, 694 Research in Botany *I and II, 3 each*
Assigned research, subject matter of which is to be arranged with a member of department and with the approval of the head of the department. *(Lab. 6)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BUSINESS EDUCATION (BED)

428 Coordinating and Developing Curriculum for Cooperative Vocational Business and Distributive Education *I, 3*

520 Research and Methods in Teaching Office Occupations Subjects *I, 3*
Psychological principles of skill building, content, methods of teaching, curriculum materials, current thought, and evaluation in the teaching of office occupations subjects. *(Lec. 3)* Staff

522 Improvement of Instruction in Social Business Subjects *II, 3*
Research, objectives, methods of instruction, curriculum materials, current thought, and evaluation in the teaching of such subjects as economics, consumer economics, economic geography, business law and general business. *(Lec. 3)* Staff

524 Foundations and Recent Developments in Business Education *II, 3*
Philosophy and objectives of business education, principles of curriculum development and evaluation, supervisory problems, organization and administration of cooperative part-time programs, historical developments, legislation, recent developments, and current status of business education. *(Lec. 3)* Staff

525 Research Seminar in Business Education *I, 3*
Analysis of research studies in the field. Research technique applied to business education. Emphasis on reading, interpretation, and application of research findings. Planning research projects. Planning and approval of outline for a field study project required. *(Lec. 3) Prerequisite: a basic course in statistics and permission of department.* Staff

526 Field Study and Seminar in Business Education *I and II, 3*
Carrying out of the field study project approved in BED 525 with attendance and participation in seminar meetings. *(Lec. 3) Prerequisite: a basic course in statistics and BED 525.* Staff

BUSINESS LAW (BSL)

500 Legal Environment of Business *I and II, 2*
Outline of American legal system; substantive rules of law in contemporary business environment; legal aspects of business transactions. *(Lec. 2)* Geffner

CHEMICAL ENGINEERING (CHE)

403, 404 (or OCE 403, 404) Introduction to Ocean Engineering Processes I and II *I and II, 3 each*

425 Process Dynamics and Control *II, 3*

437 Materials Engineering *I and II, 3*

464 Industrial Reaction Kinetics *I, 3*

471 Analysis of Engineering Data *I or II, 3*

501, 502 Graduate Seminar *I and II, 1 each*
Seminar discussions including the presentation of papers based on research or detailed literature surveys. *(Lec. 1) Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed, no more than 2 credits for the entire period.* Staff

530 Polymer Chemistry *I, 3*
Polymer structure, molecular forces, glass and crystalline transitions, solution properties, polymerization kinetics, molecular weight distribution, fractionation, viscoelastic properties and transport processes. *(Lec. 3) Prerequisite: CHM 222 and 332 or permission of instructor.* Barnett

531 Polymer Engineering *II, 3*
Polymer processing and mechanical properties of polymers. *(Lec. 3) Prerequisite: CHE 342 or 344 and 530, or permission of instructor.* Barnett

532 Ceramic Engineering *I, 3*
Properties of ceramic materials as related to starting materials and forming, densification and finishing proc-

esses. Emphasis on resulting phases and microstructure. Application of physical and chemical principles to tailor properties to engineering needs. *(Lec. 3) Prerequisite: CHE 437 or equivalent.* Rockett

533 Engineering Metallurgy *II, 3*
Structures and properties of metals and alloys required to meet typical engineering problems; proper selection of tool materials; properties of stainless steels; materials of special importance in nuclear fields, etc. *(Lec. 2, Lab. 3) Prerequisite: CHE 333 or consent of instructor.* Mairs

534 (or OCE 534) Corrosion and Corrosion Control *I, 3*
Chemical nature of metals, electrochemical nature of corrosion. Types of corrosion, influence of environment, methods of corrosion control, behavior of engineering materials, all with special emphasis on the ocean environment. *(Lec. 3) Prerequisite: permission of instructor.* Staff

535 (or OCE 535) Advanced Course in Corrosion *II, 3*
Various types of corrosion problems occurring in modern industry. In-depth comparison of the various methods available to avoid, reduce, or eliminate corrosion. Continuation of CHE 534. *(Lec. 3) Prerequisite: CHE 534 or permission of instructor.* Staff

537 Advanced Materials Engineering *II, 3*
Engineering properties, molecular design and applications of materials. Synthesis, fabrication and processing of materials. Effects of environment on materials, materials products devices and systems. *(Lec. 3) Prerequisite: CHE 437 and PHY 340 or 341.* Gielisse

538 Nuclear Metallurgy
See Nuclear Engineering 538.

539 Electron and Light Microscopy of Solids *I, 3*
Theory and physical principles governing the design and use of light and electron optical systems in identification, analysis and structural characterization of metals, ceramics, polymers, glasses and composites. Emphasis on polarized light and scanning electron microscopy. *(Lec. 3) Prerequisite: CHE 437 or equivalent.* Gielisse and Rockett

540 Phase Equilibria *II, 3*
Interpretation, construction and thermodynamics of one, two, three to n-component phase diagrams with examples of their use in chemical, ceramic, metallurgical and mineral engineering. *Prerequisite: CHM 431 or equivalent.* Rockett

572 X-ray Diffraction and Fluorescence *I, 3*
Fundamentals, properties, and applications of X-rays for identification and chemical analysis of materials, determination of lattice parameters, phase transformations, textures, residual stresses, grain and particle sizes, film and plate thicknesses. *(Lec. 2, Lab. 3) Prerequisite: PHY 340 or 341.* Mohrnheim

573 Mechanical Metallurgy *I or II, 3*
Behavior and response of metals to mechanical plastic forming. Property control by analysis and design of industrial metal processing. Principles of annealing, forging, rolling, extruding, rod, wire and tube drawing. Recent advances and developments. *(Lec. 3) Prerequisite: permission of instructor.* Mohrnheim

574 Biochemical Engineering *I, 3*
Introduction to biotechnology. Includes properties of biological materials, dynamics, control and operation of biological systems and processing of biological materials. *(Lec. 3) Prerequisite: permission of instructor. In alternate years.* Thompson

581 Introduction to Nuclear Engineering
See Nuclear Engineering 581.

582 Radiological Health Physics
See Nuclear Engineering 582.

583 Nuclear Reactor Theory
See Nuclear Engineering 583.

585 Measurements in Nuclear Engineering
See Nuclear Engineering 585.

586 Nuclear Reactor Laboratory
See Nuclear Engineering 586.

591, 592 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12). Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

613 Advanced Chemical Engineering Thermodynamics *I, 3*
Applications of the first, second and third laws of thermodynamics and their relation to chemical engineering processes. Emphasis on properties of fluids, chemical and physical equilibria and refrigeration. *(Lec. 3) in alternate years.* Votta

614 Advanced Chemical Engineering Thermodynamics *II, 3*
Continuation of CHE 613. *(Lec. 3) Prerequisite: CHE 613. In alternate years.* Votta

625 Automatic Process Control *II, 3*
Theory of automatic control as applied to industrial processing systems. *(Lec. 3) In alternate years.* Shilling

627 (or IDE 641) Molecular Aspects of Materials Processing *I or II, 3*
Detailed analysis of fundamental physical and chemical aspects of generation, fabrication and application of materials in processing. Includes major material groups, molecular nature of material interaction, and mechanical, chemical, and thermal theories of specific processing modes. *(Lec. 3) Prerequisite: CHE 437 or permission of instructor.* Gielisse

640 Transport Phenomena I *I, 3*
Analysis of transport processes in fluids with emphasis on diffusion of matter. *(Lec. 3) Prerequisite: MTH 244 and CHE 343 or permission of instructor.* Barnett

641 Transport Phenomena II *II, 3*
Interphase transfer, turbulent transport processes and boundary layer theory, with application to fixed and fluid bed processes, membrane processes, biochemical, biomedical and electrochemical systems. *(Lec. 3) Prerequisite: CHE 640.* Barnett

643 Fluid Dynamics *II, 3*
Advanced problem course dealing with isothermal and nonisothermal flow of compressible and incompressible fluids. *(Lec. 3) In alternate years.* Madsen

644 Process Heat Transfer *II, 3*
Advanced study of heat transfer by conduction in the steady and unsteady state, radiation and convection. *(Lec. 3) In alternate years.* Madsen

645 (or MCE 645) Boiling Heat Transfer and Two-phase Flow *I, 3*
Nucleation and bubble growth, pool boiling, and flow boiling. Hydrodynamics of two-phase flow, the boiling crisis, and instabilities in boiling systems. *(Lec. 3) Prerequisite: MCE 546, CHE 644 or permission of instructor. In alternate years.* Madsen and Test

646 Radiation Heat Transfer
See Mechanical Engineering 646.

647 Mass Transfer I
Advanced course dealing with the application of mass transfer theory in the distillation of binary, multi-component, and complex mixtures. *(Lec. 3) In alternate years.* Thompson

648 Mass Transfer II *II, 3*
Advanced study of mass transfer theory applied to gas-liquid, liquid-liquid and solid-liquid systems. *(Lec. 3) In alternate years.* Treybal

651, 652 Advanced Design *I and II, 3 each*
Advanced course in the coordination of chemical or nuclear engineering principles and economics to the design of complete industrial plants. Students work design problems on an individual basis, with the guidance of one or more instructors. Staff

664 Applied Reaction Kinetics *II, 3*
Application of principles of chemical reaction kinetics to industrial processes. *(Lec. 3) In alternate years.* Shilling

682 Radiation Shielding
See Nuclear Engineering 682.

683 Advanced Nuclear Reactor Theory
See Nuclear Engineering 683.

687 Nuclear Chemical Engineering
See Nuclear Engineering 687.

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12.) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CHEMISTRY (CHM)

401 Intermediate Inorganic Chemistry *I, 3*

412 Instrumental Methods of Analysis *II, 3*

414 Instrumental Methods of Analysis Laboratory *II, 2*

425 Qualitative Organic Analysis *I, 4*

431, 432 Physical Chemistry *I and II, 3 each*

501 Advanced Inorganic Chemistry I *I or II, 3*
Systematic analysis of bonding schemes and structural aspects of molecular systems encountered in inorganic chemistry. Special emphasis on electron density distributions, physical methods of analysis, and practical applications of quantum mechanics. *(Lec. 3) Prerequisit: CHM 401.* Staff

502 Advanced Inorganic Chemistry II *II, 3*
Modern inorganic chemistry approached from experimental, theoretical and descriptive points of view. Includes electronic structure and bonding in coordination chemistry, topology, thermodynamics of complex formation, mechanisms, lanthanides and actinides. *(Lec. 3) Prerequisite: CHM 401 or equivalent.* Staff

504 Physical Methods of Inorganic Chemistry *II, 3*
Theory and application of principal physical methods used in the preparation, analysis, and investigation of properties of inorganic chemicals, with emphasis on investigations concerning molecular structure and electron

density distributions in molecular systems. *(Lec. 2, Lab. 3) Prerequisite: CHM 322.* Petersen

511 (509) Advanced Analytical Chemistry I *I, 3*
Principles of aqueous and non-aqueous titration. Theory of separations including distillation, solvent extraction, and especially gas and liquid chromatography. Statistical treatment of experimental data. *(Lec. 3) Prerequisite: CHM 412 or permission of instructor.* Staff

512 Advanced Analytic Chemistry II *II, 3*
Continuation of CHM 412 with emphasis on principles and recent developments in application of physicochemical phenomena to solution of chemical problems. *(Lec. 3) Prerequisite: CHM 412, PHY 340, and MTH 243.* Staff

518 Radiochemistry *II, 3*
Theory and principles of nuclear science as applied to the various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, emphasis on solution of chemical and environmental research problems with the techniques of nuclear chemistry. *(Lec. 3) Prerequisite: CHM 432, PHY 214 or permission of instructor.* Fasching

520 Radiochemistry Laboratory *II, 1*
Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, instrumental neutron activation analysis, fission process, and uses of radioactive tracers. *(Lab. 3) Prerequisite: CHM 518 concurrently, CHM 432 and PHY 214, or permission of instructor.* Fasching

521 Advanced Organic Chemistry I *I, 3*
Emphasis on fundamental organic structure theory and reaction mechanisms. *(Lec. 3) Prerequisite: CHM 228 and 230.* Vittimberga

522 Advanced Organic Chemistry II *II, 3*
Modern synthetic reactions and their applicability to such areas as natural products and heterocyclic chemistry. *(Lec. 3) Prerequisite: CHM 521 or permission of instructor.* Cheer

529 Advanced Physical Chemistry I *I, 3*
Introduction to modern chemistry with emphasis on quantum chemistry and statistical thermodynamics. Includes development of quantum theory, applications of quantum theory, development and application of statistical distribution functions. *(Lec. 3) Prerequisite: CHM 432 or permission of instructor.* Staff

532 Advanced Physical Chemistry II *II, 3*
Principles and applications of classical physical chemistry. Includes the three laws of thermodynamics, thermochemistry, phase equilibria, kinetic rate laws, and mechanisms of gas phase reactions. *(Lec. 3) Prerequisite: CHM 432 or permission of instructor.* Staff

535 Chemical Applications of Group Theory *I, 2*
Fundamental principles of group theory developed as used in simplifying problems of a chemical nature. Group theoretical approach to several typical problems such as hybrid orbitals, molecular orbitals, and molecular vibrations. *(Lec. 2) Prerequisite: CHM 432.* Brown

536 Molecular Spectroscopy and Structure *II, 3*
Theory of molecular dynamics, interaction of electromagnetic radiation with matter. Absorption and emission spectra in infrared, far-infrared, and microwave regions. Raman scattering in the visible region. Use of spectral results in determining physical properties and elucidating molecular structures will be emphasized. *(Lec. 3) Prerequisite: CHM 535 or permission of instructor.* Brown

542 Recording Techniques for Chemical Demonstrations *II, 3*
Demonstrations illustrating significant chemical principles are planned, rehearsed and presented for closed-circuit TV and class criticism. *(Lec. 3) Prerequisite: permission of instructor. Designed to accompany the M.S. non-thesis degree in chemistry; may not be taken to fulfill required chemistry credits of other degrees.* Hamlet and MacKenzie

544 Applications of Chemical Data Processing *II, 3*
Chemical calculations in detail, individual program construction and execution. Includes inter-atomic repulsions, dipole moments, interaction of bond orbitals, filling ORD curves, calculation of spectra and quantum mechanical approximations. *(Lec. 2, Lab. 3) Prerequisite: CHM 222, 332 and a one-semester course in FORTRAN programming or equivalent experience. In alternate years, next offered 1974-75.* MacKenzie

551, 552 Non-thesis Masters Research *I and II, 3 each*
Research on original problem for fulfillment of research requirement of non-thesis master's degree. Literature survey, laboratory work and detailed report required. *(Lab. 9) Prerequisite: permission of department.*

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee. A minimum of six credits is required of students who have chosen the thesis option for the master's degree.

602 The Transition Metals *II, 3*
Structure, bonding and reaction mechanisms of transition metals and their compounds. Applications of Ligand field theory. *(Lec. 3) Prerequisite: CHM 401.* Nelson

608 (508) Inorganic Reaction Mechanisms *II, 3*
Kinetics and mechanisms of reactions in aqueous solution: techniques, results, and theoretical interpretation. Instrumentation for studying rapid reactions in solution, relaxation methods, electron transfer rates, hydrolytic and solvolytic reactions, metal ion complexation, reactions of biochemical significance. *(Lec. 3) Prerequisite: CHM 502 or permission of instructor.* Kirschenbaum

615 Trace Analysis of Inorganic Substances *I, 3*
Principles of trace analysis. Emphasis on techniques and instrumentation. The advantages and limitations of such techniques as atomic absorption spectroscopy, neutron-activation analysis, flame emission X-ray fluorescence will be presented. *(Lec. 3) Prerequisite: CHM 511 or permission of instructor.* Fasching, Burdo

616 Applied Analytical Techniques *II, 3*
Application of analytical instrumentation and techniques to practical problems. Limitations and specific difficulties of analyzing complex matrices in practical research. Problem oriented presentation. *(Lec. 3) Prerequisite: CHM 511 and 512 or permission of instructor.* P. R. Brown

617 Advanced Instrumentation *I, 3*
Basic design and theory of design of instruments. Discussion of advantages and limitations of specific instruments. Current research in instrument design and critical evaluation of designs. *(Lec. 3) Prerequisite: CHM 511 and ELE 220 or 537 or its equivalent.* Fasching, Burdo

618 Theory of Separations *II, 3*
Companion to CHM 615. In-depth presentation of theory of separation processes. Emphasis on methods development, advanced topics and current advances using gas and liquid chromatography. *(Lec. 3) Prerequisite: CHM 511 or permission of instructor.* P. R. Brown, Burdo

622 Advanced Organic Synthesis *II, 3*
Discussion of modern synthetic methods for the contruction of complex chemical structures. *(Lec. 3) Prerequisite: CHM 522.* Staff

626 Free Radicals and Photochemistry *I, 3*
Theory of formation and detection of free radicals and photoexcited states. Bond homolysis, additions, oxidation, polymerization, rearrangements and other free radical reactions. *(Lec. 3) Prerequisite: CHM 521, 522 or equivalent.* Abell

627 Organic Intermediates *I, 3*
The formation, reaction and decomposition of short-lived organic intermediates will be explored with special emphasis on the carbonium ion, carbanion and carbene species. *(Lec. 3) Prerequisite: CHM 521.* Staff

628 Organometallic Chemistry *II, 3*
The interaction of the organic and inorganic moieties and their effects upon each other. Special emphasis will be placed on the interaction of organic moieties with the transition and main group metals. *(Lec. 3) Prerequisite: CHM 502.* Rosen

634 Advanced Chemical Thermodynamics *II, 3*
Statistical thermodynamics is developed and applied to the calculation of thermodynamic properties. *(Lec. 3) Prerequisite: CHM 533 or permission of department. In alternate years, next offered 1975-76.* Kraus

638 Advanced Quantum Chemistry *II, 3*
Perturbation theory, the variational principle, time dependent perturbation theory, the helium atom, the hydrogen molecule, Hartree Foch calculations, pi electron systems, development of the Huckel molecular orbital methods. *(Lec. 3) Prerequisite: CHM 529 or equivalent.* Gonzalez

641, 642, 643, 644 Graduate Seminar *I and II, 1 each*
Results of detailed literature surveys are presented orally and in writing. Required for candidates for advanced degrees in chemistry. *(Lec. 1) S/U credit.* Staff

691 Special Topics *I and II, 2*
Covers the following special research interests: (a) carbohydrate chemistry, (b) chemical kinetics, (c) clinical chemistry, (d) computer techniques in analytical chemistry, (e) forensic chemistry, (f) free-radical rearrangements, (g) recent advances in analytical chemistry, (h) light scattering, (i) molecular orbital theory, (j) pericyclic reactions, (k) surface chemistry, (1) X-ray analysis of organic molecules. *(Lec. 2) May be repeated up to a maximum of 6 credits.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CHILD DEVELOPMENT AND FAMILY RELATIONS (CDF)

400 Child Development: Advanced Course *I, 3*

403 Human Development during Adulthood *I or II, 2-3*

450 Family Interaction *I, 3*

460 Family Life Education *II, 3*

480 Children and Families in Poverty *I or II, 3*

497, 498 Special Problems *I and II, 2-4 each*

500 Child Development Seminar *I or II, 3*
Intensive study of selected topics, such as development of cognitive processes, individual and group differences in development of language, hereditary factors in physical growth. Review papers by students presented to class. *(Lec. 3) Prerequisite: CDF 400 or permission of department.* Staff

550 Family Relations Seminar *II, 3*
Intensive study of selected topics, such as maternal deprivation, child rearing practices and attitudes, homogamy and complementary needs in marital choice. Review papers prepared by students presented to the class. *(Lec. 3) Prerequisite: CDF 355 or permission of department.* Staff

570 Field Experience with Exceptional Children *I and II, 3*
Interdisciplinary seminar and laboratory with observation and supervised projects with exceptional children. Psychological, physical and social factors pertinent to teaching in child development centers. *(Lec. 1, Lab. 4) Prerequisite: CDF 370 or equivalent and permission of department.* Staff

595 Master Project: Action Research *I and II, 1-6*
Number of credits is determined each semester in consultation with the major professor. Minimum of six credits is required of students who have chosen the action-thesis option. One to six credits may be taken. *S/U credit.*

597, 598 Advanced Study *I and II, 3 each*
Survey of important research contributions significant to understanding of human development and relationships. *(Lec. 3)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee. Minimum of six credits is required of students who have chosen the thesis option.

CIVIL AND ENVIRONMENTAL ENGINEERING (CVE)

442 Traffic Engineering *I, 3*

447 Highway Engineering *II, 3*

453 Computer Analysis of Structures *II, 3*

472 Industrial Air Pollution *I or II, 3*

473 Analysis of Air Pollutants *I or II, 3*

478 Solid Waste Disposal and Management *II, 3*

481 Soil Behavior *I, 3*

482 Soil Engineering *II, 3*

483 Foundation Engineering *I or II, 3*

491, 492 Special Problems *I and II, 1-6 each*

521 Advanced Strength of Materials *I or II, 3*
Relations between stresses at a point on different planes passing through the point. Stress concentrations and localized stress. Introduction to the analysis of statically indeterminate stresses in which methods involving elastic strain energy are used. Consideration of the plastic analysis of structures. *(Lec. 3)* Staff

524 (or OCE 524) Marine Structural Design *I or II, 3*
Includes the design of marine structures, consideration of marine construction materials, waterfront structures, ocean towers and underwater structures. *(Lec. 2, Lab. 3) Prerequisite: CVE 351.* McEwen

551 Advanced Structural Analysis *I or II, 3*
Deflections of planar structures using energy concepts and elastic curve principles. Analysis of indeterminate planar structures using advanced techniques. Flexibility and stiffness matrices. *(Lec. 3) Prerequisite: permission of department.* Staff

565 Response of Structures to Dynamic Loads *I or II, 3*
Behavior of materials and components in civil engineering structures. Numerical and exact methods applied to response in the elastic and inelastic range. Matrix analysis. *(Lec. 3) Prerequisite: permission of department.* Staff

570 Sanitary Chemistry *I, 3*
Application of analytical chemistry to analysis of natural waters; physical chemistry and organic chemistry of aqueous media; chemical principles applicable to operations of sanitary engineering. *(Lec. 3) Prerequisite: permission of instructor.* Sussman

571 Sanitary Chemistry Laboratory *II, 3*
Applications of chemical laboratory procedures to control of water and waste water treatment processes. *(Lec. 2, Lab. 3) Prerequisite: CVE 570.* Sussman

572 Biosystems in Sanitary Engineering *I or II, 3*
Microorganisms which constitute the biological systems in water pollution, water purification and waste water treatment. Application of principles of microbiology and biochemistry to analysis and design in fields of sanitary engineering and water resources. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Poon

575 Open Channel Hydraulics *I or II, 3*
Analysis of uniform, critical, varied flow, and unsteady flow in open channels. Principles will be applied to open channel design. *(Lec. 3) Prerequisite: MCE 354.* Poon

584 Principles of Pavement Design *I or II, 3*
Design of flexible and rigid type pavements. Design and control of concrete paving mixes, bituminous concrete paving mixes and current research on pavement design. Emphasis on soil engineering including stabilization, moisture movement and frost considerations. *(Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor.* Moultrop and Nacci

585 Soil Stabilization *I or II, 3*
Factors that affect soil stability. Mechanisms of soil stabilization. Design and analysis of stabilized soils. *(Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor.* Staff

586 Physio-chemical Properties of Soils *I, 3*
Influence of physio-chemical properties of soils on engineering characteristics and performance. Application of

mineralogy, ion exchange and colloidal theory; effect of marine environment; and the nature of soil water. *Prerequisite: CVE 481 or permission of instructor.* Staff

587 Ground Water Flow and Seepage Pressures *I, 3*
Hydrodynamics of fluid flow through porous media. Analytical methods for steady and unsteady seepage in aquifers; theoretical analysis with practical modification of seepage problems involving foundations, drainage structures, earth dams and wells. *(Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor.* Nacci and Wang

596 Numerical Methods in Structural Engineering *I or II, 3*
Methods of successive approximations and numerical procedures in the solution of stress, vibration and stability problems in structural members. Nonuniform members, elastic supports, plates, torsion. *(Lec. 3) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601, 602 Graduate Seminar *I and II, 1 each*
Discussions and presentation of papers based on research or detailed literature surveys. *(Lec. 1) Required of all students in graduate residence, but a maximum of 1 credit per year is allowed, no more than 2 credits for the entire period.* Staff

650 Advanced Structural Analysis *I or II, 3*
Continuation of CVE 551. Analysis of indeterminate trusses, structures with nonprismatic members, and shell and folded plate structures. Investigation of secondary stresses. *(Lec. 3) Prerequisite: permission of department.* Staff

651 Plate Structures *I or II, 3*
Fundamental theories of bending and buckling of plates with practical application to the design of structural plate components of metal and reinforced concrete. *(Lec. 3) Prerequisite: permission of instructor.* Staff

652 Shell Structures *I or II, 3*
Membrane and bending theories of thin shells and their practical application to the design of shell and folded-plate structures of metal and reinforced concrete. *(Lec. 3) Prerequisite: CVE 651 or permission of instructor.* Staff

653 Analysis of Space Structures *I or II, 3*
Analysis of three-dimensional determinate and indeterminate beams, frames, and trusses by matrix methods. Deflections and indeterminate analysis using virtual work, conjugate structure, and slope deflection procedures. Emphasis on numerical solutions using the digital computer. *(Lec. 3) Prerequisite: CVE 396, 551.* Lavelle

655 Matrix Methods in Structural Analysis *I or II, 3*
Development of finite-element methods of structural analysis. Application to stress problems and to plate and shell structures. *(Lec. 3) Prerequisite: permission of instructor.* Staff

673 Theory of Water Purification and Treatment *I, 3*
Principles of modern water purification and engineering practices. Aeration, deodorization, sterilization, coagulation, filtration, water softening, iron removal, disinfection and corrosion control. *(Lec. 3)* Campbell

674 Sanitary Engineering Laboratory *I or II, 3*
Advanced phases of sewage treatment and purification including sludge digestion, sludge gas analysis, biochemical oxygen demand, conditioning of sludge, activated sludge, sewage trickling filters and chemical precipitation. *(Lec. 2, Lab. 3) Prerequisite: CVE 679.* Poon

675 Sanitary Engineering Design *I or II, 3*
Functional design of modern water treatment plant providing treatment of water for domestic and industrial consumption. *(Lec. 1, Lab. 6) Prerequisite: CVE 679.* Poon

676 Sanitary Engineering Design *I or II, 3*
Functional design of modern sewage treatment works providing treatment of sewage. *(Lec. 1, Lab. 6) Prerequisite: CVE 673.* Campbell

677 Stream and Estuarine Analysis *I or II, 3*
Functionals and mathematical concepts of physical and biological factors applied to the evaluation of the pollution capacity of streams and estuaries. *(Lec. 3) Prerequisite: MTH 244.* Campbell

678 Industrial Waste Water Treatment *I or II, 3*
Advanced considerations of industrial waste disposal problems of major waste producing industries, including waste producing processes, composition of waste waters, treatment methods, and in-plant abatement techniques. *(Lec. 3) Prerequisite: permission of instructor.* Poon and Sussman

679 Treatment of Municipal Wastes *I or II, 3*
Theory and mathematical concepts of physical, chemical, and biological oxidation processes applied to the clarification and purification of municipal waste waters. *(Lec. 3) Prerequisite: permission of instructor.* Poon

681 Advanced Soil Mechanics *I, 3*
Index properties and physical properties of soils. Laboratory and field procedures for soil identification. Permeability and flow of water through soils. Compressibility characteristics of soils and consolidation theories as applied to settlement analysis. *(Lec. 2, Lab. 3) Prerequisite: CVE 521 or equivalent.* Nacci or Wang

682 Advanced Soil Mechanics *II, 3*
Stress analysis. Elastic theory of stress distribution in soils. Application of consolidation theory. Shearing phenomena in soils with application to bearing capacity,

earth pressure and slope stability. Pile foundation analysis. Special topics. *(Lec. 3) Prerequisite: CVE 681.* Nacci or Wang

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problems. Credits not to exceed a total of 12.) Prerequisite: permission of department.* Staff

COMMUNITY PLANNING (CPL)

410 Fundamentals of Urban Planning *I or II, 3*

434 Introduction to Community Planning History and Theory *I, 3*

501 (511) Introduction to Community Planning History and Theory *I, 3*
The development of community planning in the U.S., history of governmental planning and evolution of the planning profession, and theoretical elements and constructs basic to contemporary planning practice. *(Lec. 3)* Foster

503, 504 (603, 604) Interdisciplinary Seminar in Contemporary U.S. Environment *I and II, 3 each*
Comprehensive survey of structural change in American society and its environmental and technological settings. *(Lec. 3)* Staff

505 (613) Planning Studio I *I, 3*
Understanding of the physical environment and application of analytical planning studies, tools, techniques and inventory procedures. Methods of analysis applied to a laboratory problem involving a specific geographic area. *(Lec. 3, Lab. 3)* Staff

506 (614) Planning Studio II *II, 6*
The community plan: community facilities, future land use, economic development, and general plan implementation. Functional requirements of physical elements and their relationship in space. Actual design projects in the laboratory. *(Lec. 3 Lab. 3)* Staff

508 (642) Research Methodology *II, 3*
A basic foundation for independent research directed toward the production of a thesis at the master's degree level. Basic concepts of problem definition, formulation and testing of hypotheses, and the relation of research to theoretical concepts. *(Lec. 3)* Brooks

510 Survey of Regional, Inner-City, and Environmental Planning *I, 3*
Introductory course to acquaint students with areas of concentration within the Curriculum. After initial period of lectures, student chooses an appropriate section depending on particular interest. *(Lec. 3)* Brooks, Foster, Mahayni

520 Seminar in Regional Planning and Development *II, 3*
Regional development issues and policies in advanced and developing countries. Regional planning, development theories, methodologies, distribution of economic activities, and settlement patterns. Role of infrastructure in stimulating development processes. *(Lec. 3)* Mahayni

540 Housing in American Society *II, 3*
Housing, a process and facility; policy and market analysis at regional, state and local levels; role of government in providing housing for the poor; alternative strategies for housing the poor. *(Lec. 3)* Johnson

570 (672) Plan Implementation *I or II, 3*
Survey of tools of plan implementation, including public tools such as zoning, subdivision control, capital budgets, renewal, taxation, federal and state programs, and private tools such as mortgaging and easements. *(Lec. 3)* Staff

591, 592 (651) Special Problems in Planning *I or II, 3 each*
Individual investigation of special problems in planning. Staff

593-598 (652) Special Problems in Planning *I or II, 3 each*
Group investigation of special problems in planning. Staff

599 Masters Thesis Research *I or II, 6*
Number of credits is determined each semester in consultation with the major professor or program committee.

601 (631) Planning Law Seminar *I, 3*
General review and discussion of legal principles and thought concerned with property rights, political power, and the legal aspects pertinent to the planning and development of public and private activities. *(Lec. 3)* Brooks

606 (634) Seminar in Professional Planning Practice *II, 3*
Current planning operations in public and private organizations, staff and client relations, ethical responsibilities, interdisciplinary cooperation; work programming, new trends, legislation and planning opportunities on local, state and national levels. *(Lec. 3)* Barber

608 (661) Seminar in Planning Theory *I or II, 3*
Critical survey of planning theories and contemporary planning concepts. Values, assumptions, and processes of various planning paradigms as they relate to decisions in community planning. *(Lec. 3)* Mahayni

621 (532) (or REN 532) Land Resources Economics *I, 3*
The study of economic relationships of man and scarce natural and man-made resources. Supply and demand,

rent theory, resources conservation and the impact of public policy and law. *(Lec. 3)* Jeffrey

623 Seminar in Transportation Planning *I, 3*
The range of issues confronting planning for urban transportation systems; the variety of policies governments pursue in issues and problems; technical and political constraints; transportation studies; and demand analysis techniques. *(Lec. 3)* Barber

624 State and Metropolitan Planning *II, 3*
Institutional aspects of state and metropolitan planning; the agencies in which planning is done and the intergovernmental context of coordination and implementation. Programming, staffing, budgeting and project evaluations are examined. *(Lec. 3)* Barber

631 (636) Seminar in Urban Design *I, 3*
Significant concepts of historical and contemporary urban form ranging in scale from the city as a whole to architectural detail of public projects. Use of slides and films to illustrate the visual impact and importance of excellence in design. *(Lec. 3)* Hammerschlag

634 Environmental Law *II, 3*
Alternative policy approaches involving economical, ecological, and political sciences, technological, planning and legal disciplines in the conceptualization of protection, control and development of the environment are examined. *(Lec. 3)* Brooks

641 Manpower Planning *I, 3*
A review of manpower planning at all levels of government. Concentration on the problems of unemployment in the central city; labor supply and demand, manpower forecasting and projection techniques. *(Lec. 3)* Johnson

644 (503) Urban Planning and Politics in the Metropolis *II, 3*
Significance and impact of urban planning on growth and betterment of cities and metropolitan areas. The planning process as it relates to the formulation of community development policies and the institutional framework from which they are produced. *(Lec. 3) Prerequisite: PSC 422 or equivalent.* Foster

652 (505) Values and Prediction in Planning *I or II, 3*
Examines human needs and wants, and how decisions are influenced by society and nature. Provides a framework for the measurement and analysis of qualitative data, and for the prediction of human behavior relative to planning. *(Lec. 3)* Jeffrey

654 (633) Advocacy Planning *I or II, 3*
Relationships between residents of an urban slum and public officials in governmental agencies; citizen participation in urban renewal areas, enforcement of housing laws, selected problems of city schools, public assistance, and civil disobedience. Relationships reviewed on the basis of statutory, administrative, or contractual material. *(Lec. 3)* Brooks

691, 692 (691) Special Problems in Planning *I or II, 3*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. Staff

693-698 (692) Special Problems *I or II, 3*
Advanced work, under the supervision of a member of the staff and arranged to suit the requirements of a group of students. Staff

COMPUTER SCIENCE (CSC)

410 Introduction to Computer Science and Algorithmic Processes *I and II, 3*

411 Computer Organization and Programming *I and II, 3*

412 Programming Systems *II, 3*

413 Data Structures *I, 3*

491, 492 Problems in Computer Science *I and II, 1-3 each*

500 Scientific Applications of Digital Computers I *I, 3*
Algorithms, techniques, practical procedures for digital computers related to applications of numerical methods. Approximation methods, numerical quadrature, solution of differential equations, zeros of functions, optimization methods, error analysis. *(Lec. 3) Prerequisite: MTH 243, CSC 410 and permission of instructor.* Carrano, Hemmerle

502 Theory of Algorithmic Languages and Compilers *II, 3*
Formal description of procedure-oriented languages and the techniques used in translating algorithms written in these languages into computer programs. *(Lec. 3) Prerequisite: credit or concurrent registration in CSC 413.* Bass

505 Design of Digital Circuits
See Electrical Engineering 505.

515 Theory of Computation *I, 3*
Formal examination of several abstract models of computing machines. Functions that can and cannot be computed on the various models are characterized. *(Lec. 3) Prerequisite: CSC 410 and permission of instructor.* Bass

515 Theory of Computation *I, 3*
Turing machines, recursive functions, Shepardson-Sturgis machines, Universal Turing machines, Church's thesis, standard indexing, decision and halting problems, recursive sets, recursively enumerable sets, automata, computational complexity, Post productions. *(Lec. 3) Prerequisite: CSC 410 and permission of instructor.* Bass

525 (or IDE 525) Simulation *II, 3*
Discrete simulation models. Comparison of discrete change simulation languages. Methodology including generation of random variates, design of simulation experiments for optimization, and validation of models and results. Selected applications. *Prerequisite: CSC 410 and 6 credits is statistics.* Carney and Shao

535 Information Organization and Retrieval *II, 3*
Construction and accessing of large data bases; document classification, retrieval, and evaluation techniques; automatic dictionary and thesaurus construction; natural language content analysis; question answering systems. *(Lec. 3) Prerequisite: CSC 413.* Weiderman

551 Scientific Applications of Digital Computers II *II, 3*
Algorithms, techniques and practical procedures for digital computers emphasizing linear computations and statistical applications. Monte Carlo methods. Matrix calculations, simultaneous linear equations, matrix inversion. Least square analysis, multiple regression. Characteristic value problems. *(Lec. 3) Prerequisite: MTH 215 and CSC 410 or equivalent and permission of instructor.* Hemmerle

581 (or ELE 581) Intelligence in Machines and Humans *I or II, 3*
Formal theories of human information processing. State-space representation and search. Problem-reduction representations. Predicate calculus for theorem-proving and problem-solving. Semantic information processing. Artificial intelligence programming languages. *(Lec. 3) Prerequisite: permission of instructor.* Birk

582 Robotics
See Electrical Engineering 582.

583 Computer Vision
See Electrical Engineering 583.

591, 592 Problems in Computer Science *I and II, 1-3 each*
Advanced work in computer science. Conducted as seminars or as supervised individual projects. *(Lec. or Lab. arranged)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ECONOMICS (ECN)

401 Poverty in the United States *I or II, 3*

402 Urban Economics *I or II, 3*

464 Comparative Economic Systems *I or II, 3*

503 Development of the United States Economy *I, 3*
Process of economic development, as illustrated by the economy of the United States. *(Lec. 3) Prerequisite: ECN 126, and either HIS 141, 142 or ECN 302, or permission of instructor.* Haller

512 History of Economic Analysis *II, 3*
Advanced work on formative developments in economic thought from classical political economy to modern welfare economics. Emphasis on relationships between doctrines and their institutional setting. *(Lec. 3) Prerequisite: permission of instructor.* Schurman

515, 516 Economic Research *I and II, 3 each*
Independent research. *S/U credit.* Staff

527 Macroeconomic Theory *I, 3*
Static and dynamic models of aggregate economic behavior developed and analyzed. *(Lec. 3) Prerequisite: ECN 327 and 375 or equivalent, or permission of instructor.* Hume

528 Microeconomic Theory *I, 3*
Analytic tools of optimization. Neoclassical price and distribution theory. Linear programming and production theory. General equilibrium and welfare economics. *(Lec. 3) Prerequisite: ECN 328 and 375 or equivalent, or permission of instructor.* Rayack

532 Industrial Organization and Public Policy *II, 3*
Theoretical and empirical analysis of structure of industrial markets; behavior and performance of business firms in the American economy; government-business relationship and its effect on formulation of public economic policy. *(Lec. 3) Prerequisite: ECN 337 or permission of instructor.* Dirlam

538 International Economics: Theory and Policy *I or II, 3*
Theory of international trade and applications to current problems. *(Lec. 3) Prerequisite: ECN 327 and 328 or permission of instructor.* Suzawa

539 Welfare Economics *I or II, 3*
Welfare criteria; conditions of optimality; causes of non-optimality and implied correctives; alternative social decision-making techniques. *(Lec. 3) Prerequisite: ECN 327 and 328 or permission of instructor.* Hume

543 Public Finance and Fiscal Policy *I, 3*
Analysis of private wants and public needs. Serves as introduction to a searching examination of such federal and federal-state fiscal problems as budgetary theory and procedures, tax theory and reform. *(Lec. 3) Prerequisite: ECN 342 or permission of instructor.* Starkey

552 Monetary Theory and Policy *II, 3*
Analysis of structure and functioning of monetary and banking systems; discussion of contemporary monetary theories; evaluation of monetary policies. *(Lec. 3) Prerequisite: ECN 334 or permission of instructor.* Barnett

566 Economic Planning and Public Policy in Developing Nations *II, 3*
Resource and financial planning in public and private sectors of developing nations with emphasis on planning tools, allocation of domestic and foreign resources, and on national economic policies. *(Lec. 3) Prerequisite: ECN 327 and 363 or 464, or equivalent, or permission of instructor.* Suzawa

575 Introduction to Mathematical Economics *I or II, 3*
Application of quantitative methods to economic problems, such as general equilibrium theory, optimal growth and stabilization models. *(Lec. 3) Prerequisite: ECN 375, 327 and 328 or permission of instructor.* Hume

576 Econometrics I *II, 3*
Application of statistics and mathematics to economic analysis. Implications of assumptions required by statistical methods for testing economic hypotheses. Current econometric methods will be examined and discussed. *(Lec. 3) Prerequisite: ECN 126 or 376 and 6 credit hours of statistics, or permission of instructor.* Ramsay

577 Econometrics II *II, 3*
Continuation of Econometrics I. *(Lec. 3) Prerequisite: ECN 576 or permission of instructor.* Lampe

595 Problems of Modernization in Developing Nations
See Resource Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

627 Advanced Macroeconomic Theory *II, 3*
Post-Keynesian macroeconomic theory, growth and cyclical models, current development in national income analysis. *(Lec. 3) Prerequisite: ECN 527 and 528 or permission of instructor.* Hume

628 Advanced Microeconomic Theory *II, 3*
Neoclassical value and distribution theory. Theories of imperfect competition, general equilibrium theory and dynamic analysis. *(Lec. 3) Prerequisite: ECN 527 and 528 or permission of instructor.* Ramsay

690 National Income *II, 3*
Advanced macroeconomic theory. *(Lec. 3) Prerequisite: ECN 126 or 990 or permission of instructor.* Hellman

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

990 Principles of Economics *I and II, 3*
Survey of micro- and macroeconomic theory. *(Lec. 3) Graduate credit for matriculated M.B.A. students only.* Hellman

EDUCATION (EDC)

401 Development and Utilization of Instructional Materials *I and II, 3*

403 History of Education *I, 3*

407 Philosophy of Education *II, 3*

409 Health Aspects of Aging *I and II, 3*

410, 411 Seminar and Supervised Field Practicum in Education of the Aging *I and II, 3 each*

424 Teaching and Reading *I and II, 3*

450 Introduction to Counseling *I and II, 3*

478, 479 Problems in Education *I and II, 1-3 each*

490 Home Economics Education Grades 1 through 6 *I and II, 2*

491 Home Economics Education Teaching Adults *I and II, 3*

503 Education in Contemporary Society *I and II, 3*
Analysis of contemporary social and economic characteristics of society that affect education. Evaluation of school as a social institution, with emphasis on the role education plays in progressive development of democratic society. *(Lec. 3)* Hagey

504 Adult Basic Education *I and II, 3*
Teaching of adults whose educational levels is below high school completion. Physical, social and psychological characteristics of disadvantaged adults and various techniques and materials useful in motivating and teaching them. *(Lec. 3) Prerequisite: permission of instructor.* McCreight and Staff

505 Principles and Practices of Leadership Development for Youth and Adult Programs *I or II, 3*
Philosophy and interrelationships of vocational-technical and general education with extension education and other community educational agencies; leadership concepts and implications; methods and techniques for increasing the effectiveness of organizations. *(Lec. 3) Prerequisite: permission of instructor.* McCreight

506 Methods of Teaching Home Economics *I or II, 3*
Selection, organization and use of instructional materials, methods and techniques of teaching home economics. *(Lec. 3)* P. Kelly

507 Curriculum Study in Home Economics *I or II, 3*
Developing a philosophy and acquiring findings about students, school programs, communities, and current trends as a basis for constructing a scope and sequence plan for a homemaking program. Units of work developed for various age groups. *(Lec. 3)* P. Kelly, May, MacKenzie

508 Supervision of Home Economics *I or II, 3*
Primarily for homemaking teachers who wish to become supervising teachers and work with college student teachers majoring in home economics teacher education. *(Lec. 3)* P. Kelly, MacKenzie

509 Seminar in Home Economics Education *I or II, 3*
Critical study of research literature and research techniques appropriate to solution of problems in home economics. *(Lec. 1-3)* Cusack, P. Kelly

510 Practicum in Incorporating Televised Media *I, 3*
Students develop skills in scripting and producing educational television programs. Application of knowledge of directing video tapes. *(Lec. 1, Lab. 4) Prerequisite: EDC 401 or permission of department.* Hicks

511 Evaluation of Film and Recorded Material *I, 3*
Theory and principles of basic educational film processes. History of educational motion pictures, social and cultural implications of film, and standards for its evaluation and use in the schools. *(Lec. 1, Lab. 4) Prerequisite: EDC 401 or permission of department.* Howard

512 Organization and Administration of Audiovisual Programs *II, 3*
Organization and administration of media departments in public schools. Media design and logistics, facility design, finance and organization. Planning in-service training programs. *(Lec. 2, Lab. 2) Prerequisite: EDC 401 or permission of department.* Cresser

513 Research and Theory in Instructional Technology *II, 3*
Research methodology in the field of media as it applies to education. Research designs including survey, descriptive and experimental types evaluated. *(Lec. 2, Lab. 2) Prerequisite: EDC 401 or permission of department.* Howard

514 Current Trends in Elementary Education *I, 3*
For teachers and administrators, the most effective use of instructional materials, media of communication, and personnel in elementary school. *(Lec. 3) Prerequisite: EDC 529 or permission of department. In alternate years, next offered 1975-76.* Nally

520 Teaching of Arithmetic *I, 3*
For the experienced teacher, examination of the principles underlying teaching of arithmetic in the elementary school, comprehensive survey of materials and methods available for the classroom teacher of arithmetic. *(Lec. 3) Prerequisite: senior or graduate standing. In alternate years, next offered 1974-75.* Nally

523 Physical Factors Related to Reading Disability *I, 3*
Investigation and evaluation of various physical factors contributing to reading disability. Visual, hearing, and speech deficiencies, motor adjustments, glandular deficiencies, general health, brain damage and congenital word-blindness, lateral dominance. Screening tests and instructional procedures for use in various areas. *(Lec. 3) Prerequisite: EDC 561 and permission of instructor. In alternate years, next offered 1975-76.* Staff

526 Teaching the New Grammars *I, 3*
Implications of the newer grammars for the teaching of English, including a review of the history of grammar, traditional grammar, and as needed, the linguistic theory necessary to an understanding of the newer grammars. *(Lec. 3) Prerequisite: graduate standing and/or certification to teach English.* DiBiasio

528 Teaching Language Arts *II, 3*
Phonics, grammar, lexicography, and usage in American English for the elementary school classroom teacher. Presentation, use, evaluation, and development of methods and materials for students in the classroom. *(Lec. 3) In alternate years, next offered 1974-75.* Nagel

529 Foundations of Educational Research *I and II, 3*
Analysis of the current major research approaches to educational problems with emphasis on interpreting published research involving the language of statistics. Functional skills in basic descriptive statistics needed prior to enrolling. *(Lec. 3)* MacMillan and Purnell

531 (or FNS 531) Teaching of Nutrition *I or II, 3*
Development of curriculums in nutrition education for teachers in grades K through 12 and appropriate programs for community nutrition educators. Emphasis on innovative teaching techniques using latest nutrition knowledge. *(Lec. 3) Prerequisite: graduate standing and permission of department.* Dymsza and MacKenzie

534 Mathematics in the Secondary School *II, 3*
Implementation of a modern mathematics program in the secondary school through a study of modern mathematics concepts, experimental programs, and instructional planning. *(Lec. 3) Prerequisite: 15 credits in mathematics.* Pezzullo

541 Reading in Secondary School Content Subjects *I and II, 3*
Designed especially to help junior and senior high school teachers to cope with the reading problems in their subject areas. *(Lec. 3) Prerequisite: EDC 313 or permission of department.* Aukerman

550 Vocational Information and Career Development *I and II, 3*
Classification and description of jobs and industries; study of occupational trends; needs of special groups entering the labor market; vocational development theories and counseling for long-range career planning. *(Lec. 3) Prerequisite: EDC 450 and graduate standing.* Maynard

551 Counseling Techniques *I and II, 3*
Foundation of the theory and practice, with special emphasis upon approaches to counseling in various educational settings; primarily designed for preparation of school counselors and student personnel educators. *(Lec. 3) Prerequisite: EDC 450 and graduate standing.* Rife

552 Group Procedures in Counseling *I and II, 3*
Principles and techniques of group counseling applied to education, counseling, and student personnel work. An experiential and didactic approach with emphasis upon facilitation techniques, leadership patterns, and counseling skills. *(Lec. 3) Prerequisite: permission of instructor.* Staff

553 Counseling Practicum *I and II, 3*
Advanced counseling. Multiple counseling sessions using tapes and supervised observation included to help measure individual assessment of growth and competence. *(Lec. 1, Lab. 5) Prerequisite: EDC 450, 550, 551, PSY 434, and permission of instructor.* Gunning

554 Individual Appraisal in Guidance *II, 3*
Nature of the appraisal process and data essential to understanding the educational, vocational and social needs of persons. Emphasis is upon the team approach in pupil personnel services and the use of the case materials. *(Lec. 3) Prerequisite: PSY 434 and EDC 551.* Gunning

555, 556 Supervised Field Work and Seminar in Guidance and Counseling *I and II, 3 each*
Students apply and integrate guidance and counseling theories and skills in selected school systems. 200 clock hours of laboratory experience required in addition to the seminar for two semesters' work. *(Lec. 2, Lab. 3) Prerequisite: EDC 554 and permission of instructor.* Pascale, Maynard, Rife and Quinn

557 Principles and Practices of Student Personnel Services in Higher Education *I, 3*
Survey of the historical, psychological, organizational, and educational factors which have evolved and combined to form student personnel work. *(Lec. 3) Prerequisite: EDC 553 and 554.* Quinn

558 Organization and Administration of Student Personnel Services in Higher Education *II, 3*
Systematic analysis of current practices in the alignment and operation of student personnel services, with continuing review of their interrelationships with the total educational program. *(Lec. 3) Prerequisite: EDC 553, 554 and 557.* Quinn

561 Analysis of Reading Disabilities *I, 3*
Causes of reading difficulties and the administration of diagnostic reading tests. Emphasis on construction and use of informal tests and standardized measures. Practice in analyzing data from case histories and in making individual case studies. *(Lec. 3, Lab. 2) Prerequisite: EDC 524 and permission of instructor.* McGuire

562 Techniques in Remedial Reading *II, 3*
Practices effective in teaching remedial reading in both the regular classroom and remedial reading clinics. Analysis of published materials. Methods of building new materials, discussion and demonstration of their practical application. *(Lec. 3, Lab. 2) Prerequisite: EDC 561 and permission of instructor.* McGuire

563 Reading Programs for the Disadvantaged *I, 3*
Impact of the culture of the disadvantaged upon the child and his response to learning and the school, with special emphasis on reading and the adjustment of reading materials and methods to individual socio-economic-cultural differences. *(Lec. 3) Prerequisite: EDC 424 or permission of instructor.* Bumpus

564 Beginning Reading Programs *II, 3*
Analysis of various approaches to reading instruction (other than the basal method) including phonetic, linguistic, language arts, programmed, and other experimental systems. Current materials analyzed and classified. *(Lec. 3) Prerequisite: EDC 424.* Aukerman

565 Analysis and Evaluation of Current Research in Reading *II, 3*
Concise analysis of the latest research in reading. Criteria for the evaluation of reading research data as it applies to both teacher and learner. Location and application of current research to reading programs. *(Lec. 3) Prerequisite: EDC 424 and permission of instructor. In alternate years, next offered 1975-76.* McGuire

566, 567 Practicum in Reading *I and II, 3 each*
Supervised case studies, practicum and seminar reports on an individual reading project at either elementary or secondary level. Lecture and/or laboratory. 120 hours plus seminar. *Prerequisite: EDC 562 and permission of instructor.* McGuire

570 Elementary School Curriculum *II, 3*
Modern curriculum in the elementary school with emphasis on the needs of children. Covers language, arts, social studies, science, arithmetic and special subjects. *(Lec. 3) Prerequisite: EDC 503, 529 or equivalent. In alternate years, next offered 1975-76.* Staff

571 The Secondary School Curriculum *II, 3*
Intensive study of basic principles and procedures utilized in developing curriculum materials. Emphasis given to content of all curriculum areas in junior and senior high schools. *(Lec. 3) Prerequisite: EDC 503, 529. In alternate years, next offered 1974-75.* Whitcomb

572 Cooperative Supervision *I and II, 3*
Analysis of function, principles and techniques of democratic cooperative supervision of teachers and other school officials. Application of these principles to supervisory problems of principals, heads of departments, special supervisors and critic teachers. *(Lec. 3) This course meets certification requirements for Critic Teacher Certificate.* Heisler

573 Seminar—Educational Research *I and II, 1*
For master's degree candidates developing a thesis. Presentations of thesis topics, research designs, and research findings. Orderly development of research studies. Graduate students who require assistance with their thesis problems must enroll for this course unless they are enrolled for thesis credit. *Prerequisite: registration for thesis.* Staff

574 Current Trends in Secondary Education *I and II, 3*
Effective use of instructional materials, media of communication, and organization of personnel and current research. *Prerequisite: EDC 529, 571 or permission of department.* Staff

575, 576 Supervised Field Study and Seminar in Elementary or Secondary Education *I and II, 3 each*
For non-thesis candidates. Lectures, seminars and field work. Candidates plan and carry out a field study project approved by the instructor. The completed project report must be successfully defended during semester. *Prerequisite: admission to a master's program in education and permission of instructor.* Kelly

577 Organization and Administration in Elementary School *I, 3*
Functions and duties of elementary school principals. *(Lec. 3) In alternate years, next offered 1975-76.* Nagel

580 Organizing and Administering Youth Programs *I or II, 3*
Planning, organization, instruction and supervision of youth programs. Includes vocational-technical and general education in their relationship to extension education and other community agencies. Youth guidance and psychological development emphasized. *(Lec. 3) Prerequisite: EDC 505 or permission of instructor.* McCreight

581 Organizing and Administering Programs of Adult Education *I or II, 3*
Planning, organization, instruction and supervision of continuing education for adults in both vocational-technical and general education as conducted by extension education and other community agencies. *(Lec. 3) Prerequisite: EDC 505 or permission of instructor.* McCreight

582 Curriculum Development in Vocational-Technical and Extension Education *I, 3*
Principles and processes involved in the basic concepts affecting vocational-technical and extension education programs. Emphasis on planning, execution and evaluation. *(Lec. 3) Prerequisite: EDC 580 or 581 or permission of instructor.* McCreight

583 Analyzing Community Needs and Resources for Youth and Adult Programs *I, 3*
Helps the student function effectively in the role of change-agent in a community setting. Concepts of goals, change, power and community will be considered in relation to student's community experiences. *(Lec. 3) Prerequisite: permission of instructor.* Bromley

584 The Adult and the Learning Process *I and II, 3*
Examination of the adult as a learner with emphasis on the factors that affect adult learning. *(Lec. 3) Prerequisite: EDC 581 or permission of instructor.* Bromley

585 Seminar on Leadership for Youth and Adult Programs *II, 3*
Students will participate in a non-structured group to observe the emergence of leadership and the effects of individual behavior on self and others. *(Lec. 3) Prerequisite: open to program majors with permission of instructor.* Bromley

586, 587 Problems in Education *I and II, 3 each*
Advanced work for graduate students in education. Courses conducted as seminars or as supervised individual projects. *(Lec. or Lab.) Prerequisite: permission of department.* Staff

588, 589 Supervised Field Practicum and Seminar in Youth and Adult Education *I and II, 3 each*
Leadership principles and practices applied in selected clinic systems. 200 clock hours of practicum are required in addition to the seminar. *(Lec. 2, Lab. 3) Prerequisite: EDC 582, 583, or 584 and 529, or permission of instructor.* Bromley, McCreight

590 Social Issues in Urban Education *II, 3*
Current social problems confronting teachers in urban education. Emphasis on current problems from perspective of sociology, social welfare, psychology and education. Field trips, visiting lecturers and sensitivity training all utilized in development of issues. *(Lec. 3) Prerequisite: EDC 102.* Staff

594 Organization and Supervision of Reading Programs *II, 3*
Various roles of the reading specialist in relation to the other line-staff personnel. Problems concerning the orientation of new teachers, reading research and development, in-service programs, and community support. *(Lec. 3) Prerequisite: EDC 562. In alternate years, next offered 1975-76.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ELECTRICAL ENGINEERING (ELE)

411 Microwave and Quantum Electronics *I, 3*

413 Microwave and Quantum Electronics Laboratory *I, 3*

417 Direct Energy Conversion *II, 3*

427 Electromechanical Devices and Systems *I, 3*

431 Electrical Engineering Materials I *I, 3*

432 Electrical Engineering Materials II *II, 3*

433 Electrical Engineering Materials Laboratory *II, 3*

436 Communication Systems *I and II, 3*

437 Introduction to Photo-electronic Devices *I and II, 3*

443 Electronics II *I, 5*

444 Electronics III, Pulse and Digital Circuits *II, 4*

457 Feedback Control Systems *I, 3*

458 Systems Laboratory *II, 3*

481, 482 Biomedical Engineering Seminar I and II *I and II, 1 each*

484 Modeling of Physiological Systems *II, 3*

491, 492, 493 Special Problems *I and II, 1 each*

501 Linear Systems Theory *I, 3*
Transform analysis of discrete and distributed systems, functions of a complex variable, state variable description of systems and time domain analysis, matrices and linear spaces, feedback concepts. *(Lec. 3)* Staff

503 (or MCE 503) Linear Control Systems *I or II, 3*
Concepts of controllability and observability, state feedback, quadratic performance indices and optimal linear control, frequency response properties of optimal feedback regulators, observer theory and state estimation, modern control system design. *(Lec. 3) Prerequisite: ELE 501 or equivalent.* Lindgren, Palm

505 (or CSC 505) Design of Digital Circuits *I, 3*
Analytical development of methods for digital circuit design. Computer arithmetic, control, and memory elements. Design of sequence generators. Special purpose digital circuits for performing numerical operations such as integration, smoothing and filtering. *(Lec. 3)* Tufts

506 Digital Signal Processing *II, 3*
Digital representations of signals and noise, digital filtering and spectral analysis, design of digital circuits for signal parameter estimation and signal detection. *(Lec. 3) Prerequisite: one course from ELE 509, OCE 561, IDE 411, or MTH 451.* Tufts

509 Systems with Random Inputs *I or II, 3*
Discrete and continuous linear systems with random inputs. Introduction to random processes in the context of linear systems. Applications to detection, smoothing and prediction. *(Lec. 3) Prerequisite: knowledge of differential equations, linear systems and transform methods.* Staff

511 Electromagnetic Fields *I, 3*
Review of electrostatics and magnetostatics. Maxwell's equations, wave propagation in dielectric and conducting media. Boundary phenomena. Radiation from simple structures. Relations between circuit and field theory. *(Lec. 3)* Staff

514 Microwave Electronics *I or II, 3*
Electronic engineering at microwave frequencies, microwave circuit theory, impedance transformation and matching, passive microwave devices, microwave tubes, semiconductor microwave electronics, microwave masers, parametric amplifiers. *(Lec. 3) Prerequisite: ELE 411 concurrently or permission of instructor.* Daly

515 Quantum Electronics *I or II, 3*
Laser engineering and applications, interaction of radiation with atoms, optical resonators, electro-optic modulation, harmonic generation, parametric oscillation and frequency conversion, noise in laser amplifiers and oscillators. *(Lec. 3) Prerequisite: PHY 341 or permission of instructor.* Daly

516 Planetary Electrodynamics *I or II, 3*
Introduction to description and theory of natural electric and magnetic phenomena on the earth and in the solar system such as lightning, natural geomagnetic and interplanetary magnetic fields, origin and properties of ionospheres, the "solar wind" and natural radio noise. *(Lec. 3) Prerequisite: permission of instructor.* Polk

517 Magnetofluidmechanics
See Mechanical Engineering 517.

520 Fourier Optics *I or II, 3*
Application of Fourier analysis in optical imaging and data processing. Systems concepts will be stressed. Scalar diffraction, lenses, coherent and incoherent imaging, spatial filtering and optical information processing, and holography. *(Lec. 3) Prerequisite: ELE 313 or an equivalent basic knowledge of Fourier analysis.* Spence

531 Solid State Engineering I *I and II, 3*
Periodicity of solids; dielectric, thermal, optical and electromagnetic properties of electronically interesting solids. *(Lec. 3) Prerequisite: ELE 431 or equivalent.* Staff

532 Solid State Engineering II *I and II, 3*
Semiconductor physics, transport properties. Applications including solid state lasers, piezoelectric, ferroelectric and magnetic devices. *(Lec. 3) Prerequisite: ELE 531 or equivalent.* Staff

535 Transistor Circuits *I and II, 3*
Semiconductors, characteristics of junction transistors. Analysis and design of single and multistage amplifiers including feedback. High frequency considerations, applications to systems. *(Lec. 3)* Staff

536 Semiconductor Electronics *I or II, 3*
Theory and technology of semiconductor devices. Junction, field effect, optoelectronic and microwave devices. Integrated circuits. *(Lec. 3) Prerequisite: ELE 431 or equivalent.* Sadasiv

537 Electronic Instrumentation and Control Circuits *I and II, 3*
Analysis and design of special amplifiers, operational circuitry, measurement of non-electrical quantities, transducers. *(Lec. 3)* Staff

538 Principles of Remote Sensing *I or II, 3*
Theory and techniques of remote sensing including spaceborne photometry and radiometry. Applications selected from the following topics: planetary atmospheres, geology and earth resources, environmental problems. *(Lec. 3) Prerequisite: ELE 323, PHY 406, or permission of instructor.* Staff

539 Infrared Imaging Techniques *I or II, 3*
Elemental detectors and their application in radiometers and scanners. Principles of infrared imaging devices. Thermal radiation and its propagation through the atmosphere. *(Lec. 3) Prerequisite: ELE 437 or equivalent.* Staff

545 Optimization and Variational Problems in Electrical Engineering *I or II, 3*
Application of variational and approximation techniques to boundary value field problems, extremal control of dynamic systems, optimization in communication theory and optimal filter theory. *(Lec. 3) Prerequisite: ELE 501 or 511 or permission of instructor.* Poularikas

560 Introduction to Data Collection Systems
See Ocean Engineering 560.

561 Information Transmission *I or II, 3*
Introduction to information theory. Discrete and continuous communications channels. Techniques for coding and decoding information. *(Lec. 3) Prerequisite: ELE 509 or equivalent.* Kelley and Spence

565 Fundamentals of Signal Theory *I and II, 3*
Concepts of signal expansions in sets of orthogonal functions other than Fourier, classification of signal types. Optimum representation vocabulary, matrix analysis. *(Lec. 3) Prerequisite: ELE 501 or equivalent.*

571 (or OCE 571) Underwater Acoustics I *I, 3*
Wave equation, energy, pressure and particle velocity. Acoustic properties of the sea. Elementary sources, refraction, reflection, ray theory, normal modes and scattering, with emphasis on sound propagation in the ocean. *(Lec. 3)* Moffett

575 Electroacoustical Engineering I *I and II, 3*
Theory and design of electroacoustic transmission channels and the psychoacoustic aspects of their use for high-quality music transmissions. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Etzold

576 Electroacoustical Engineering II *I and II, 3*
Storage of sound, studio-design and acoustical measurements. *(Lec. 2, Lab. 3) Prerequisite: ELE 575.* Etzold

581 Intelligence in Machines and Humans
See Computer Science 581.

582 (or CSC 582) Robotics *I or II, 3*
Description, design and control of industrial and research robots. Tactual and visual sensing systems. Computer control of manipulators. Object descriptions for manipulation. Obstacle avoidance. Applications. *(Lec. 3) Prerequisite: knowledge of matrix algebra and Laplace transforms or permission of instructor.* Birk

583 (or CSC 583) Computer Vision *I, 3*
Algorithms used to extract information from two-dimensional images. Picture functions. Template matching. Region analysis. Contour following. Line and shape descriptions. Perspective transformations. Three dimensional reconstruction. Image sensors. Interfacing. Applications. *(Lec. 3) Prerequisite: MTH 362 or equivalent.* Staff

584 (or EST 584) Pattern Recognition *II, 3*
Random variables, vectors, transformations, hypothesis testing and errors. Classifier design: linear, non-parametric, approximation procedures. Feature selection/extraction: dimensionality reduction, linear and non-linear mappings, clustering and unsupervised classification. *(Lec. 3) Prerequisite: ELE 509 and CSC 410 or introductory probability and statistics, knowledge of computer programming.* Kelley

586 Biomedical Electronics I *I and II, 3*
Design and analysis of biomedical instrumentation and transducers for both implantation and external use. Direct current and wide band amplifiers, counter, trigger and timing circuits. *(Lec. 3) Prerequisite: ELE 342 or equivalent.* Jaron

587 Biomedical Electronics II *I and II, 3*
Principles of bio-telemetry. Measurement of cardiovascular, metabolic and respiratory activity under dynamic conditions. Use of ultrasonics and microwaves in measuring properties of physiological tissue. *(Lec. 3) Prerequisite: permission of department.* Jaron

588 Biomedical Engineering I *I and II, 3*
Origin and characteristics of electrical potentials, transport and diffusion phenomena, dielectric and thermal properties of physiological material. Principles of electromyography, electrocardiography, and electroencephalography. Neural pathways and synaptic transmissions. *(Lec. 3) Prerequisite: permission of department. Taught in cooperation with zoology and pharmacology departments.* Jaron

589 Biomedical Engineering II *I and II, 3*
Analysis of cardiovascular, respiratory, neurological, muscular, gastrointestinal and urinary systems using mathematical tools, electronic and analog models. Use of computers for biomedical data analysis and processing. Correlation and auto-correlation techniques. *(Lec. 3) Prerequisite: permission of department. Taught in cooperation with zoology and pharmacology departments.* Jaron

591, 592 Special Problems *I and II, 1-3 each*
Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601, 602 Graduate Seminar *I and II, 1 each*
Seminar discussions including the presentation of papers based on research or detailed literature surveys. *(Lec. 1) Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed, no more than 2 credits for the entire period.* Staff

605 Non-linear System Analysis *I and II, 3*
Iteration and perturbation techniques, phase plane and state space concepts, Liapunov's direct method, stability criteria for non-linear systems. *(Lec. 3) Prerequisite: ELE 501 or equivalent.* Lindgren

613 Waveguides and Resonators *II, 3*
Theory of homogeneous isotropic waveguides and cavity resonators. *(Lec. 3) Prerequisite: ELE 511 or equivalent.* Daly or Poularikas

615 Antennas and Radio Propagation *I and II, 3*
Analysis of simple linear and area antennas. Antenna arrays. Diffraction theory. Introduction to radio propagation. *(Lec. 3) Prerequisite: ELE 511 or equivalent.* Spence or Polk

616 Advanced Topics in Electromagnetic Theory *II, 3*
Electromagnetic theory of inhomogeneous and anisotropic media. Ferrite devices. Introduction to the theory of plasmas. Ionospheric radio propagation. *(Lec. 3) Prerequisite: ELE 511, 613, 615, or equivalent.* Daly or Polk

631 Electronics of Solids I *I and II, 3*
Properties of conductors, semiconductors, and insulators from quantum mechanical principles. Band theory of solids, superconductivity, thermoelectricity. *(Lec. 3) Prerequisite: PHY 570 or equivalent.* Mitra

632 Electronics of Solids II *I and II, 3*
Extension of ELE 631, directed toward the examination of theoretical concepts fundamental to solid state electronics. Topics on current research programs and selected from areas such as quantum electronics, transport properties in strong electric and magnetic fields, and superconductivity. *(Lec. 3) Prerequisite: ELE 631 or equivalent.* Mitra

636 Solid State Electronic Devices *I or II, 3*
Selected topics of current research interest. Materials will be drawn from recent literature on solid state electronic devices. *(Lec. 3) Prerequisite: ELE 536.* Sadasiv

637 Photo-electronics I *I, 3*
Optics, including photometry, radiometry, natural illumination, irradiance, luminance, radiance, temperature. Theory, analysis and specifications of photodetectors, scanners and associated systems. Direct viewing image tubes, their components and electron optics. *(Lec. 3) Prerequisite: ELE 437 or equivalent.* Staff

638 Photo-electronics II *II, 3*
Continuation of ELE 637: theory, analysis, specifications of signal generating (remote) tubes and solid state devices, including transfer characteristics, spectral responses, limiting resolution modulation transfer function, quantum detective efficiency. Applications to medicine, space, night vision. *(Lec. 3) Prerequisite: ELE 637.* Sadasiv

641 Advanced Engineering Analysis I *I, 3*
Analytical techniques for the solution of problems involving a finite number of degrees of freedom with applications to linear and non-linear systems. *(Lec. 3) Prerequisite: advanced graduate standing and permission of instructor.* Staff

642 Advanced Engineering Analysis II *II, 3*
Continuation of ELE 641. Techniques for the analysis of distributed parameter systems. Applications to diffusion problems and wave propagation. *(Lec. 3)* Staff

651 Feedback Control Systems I *I, 3*
Analysis of synthesis of complex control systems. Extension of feedback control theory to handle random disturbances, sampled data, and non-linearities. System optimization. *(Lec. 3) Prerequisite: ELE 457 or equivalent.* Staff

652 Feedback Control Systems II *II, 3*
Continuation of ELE 651. Topics from current research such as stability of non-linear and time-varying systems, optimal control, self-optimizing systems and learning systems. *(Lec. 3) Prerequisite: ELE 651.* Staff

660 Advanced Topics in System Theory *I or II, 3*
Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. *(Lec. 3) Prerequisite: permission of instructor.* Staff

665 Detection, Estimation and Modulation Theory *I or II, 3*
Advanced treatment of statistical detection, estimation and modulation theory. Applications to communication systems and radar and sonar systems. *(Lec. 3) Prerequisite: ELE 509 or equivalent and competence in probability and statistics.* Staff

672 (or OCE 672) Underwater Acoustics II *II, 3*
Transducers, radiators and receivers, directivity (array structures), equivalent circuits, efficiency; piezo-electricity, magnetostriction, sonar principles, measurements and calibration. *(Lec. 3).* Moffett

691, 692 Special Problems *I and II, 1-3 each*
Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ENGLISH (ENG)

440 Literary Heritage of New England to 1860 *I 3*

444 The American Writer and the Negro *II, 3*

446 Modern American Drama *II, 3*

447* (343) Twentieth Century American Poetry *I and II, 3*

448* (341) The Nineteenth Century American Novel *I and II, 3*

449* (342) The Twentieth Century American Novel *I and II, 3*

454 (365) Modern British and European Drama *I and II, 3*

455* (353) Twentieth Century British Poetry *I and II, 3*

458* (351) The British Novel *I and II, 3*

459* (352) The British Novel: Victorian and Modern *I and II, 3*

462 The Medieval and Modern Epic *II, 3*

468* (361) The European Novel to 1850 *I and II, 3*

469* (362) The European Novel After 1850 *I and II, 3*

470* Chaucer *I, 3*

472, * 473 * Shakespeare *I and II, 3 each*

474* Milton *II, 3*

477 (433) The Elizabethan Drama *I or II, 3*

478 English Drama of the Restoration and Eighteenth Century *I or II, 3*

*Not acceptable as graduate credit for concentration in English.

485 American Authors *I or II, 3*

486 British Authors *I or II, 3*

510 Bibliography and Literary Research *II, 3*
Use of descriptive and analytical bibliography, various modes of literary criticism, and other scholarly tools in the solution of literary research problems. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Reaves and Titus

530 History of the English Language *I, 3*
Historical study of development of English syntax, sounds, vocabulary and usage. *(Lec. 3) Prerequisite: graduate standing or permission of the instructor.* Titus

531 History of Critical Theory *II, 3*
Important critical theories from Aristotle to the twentieth century. Emphasis upon orientation of theories to various aspects of the literary situation. Some study of modern attitudes toward earlier critics. Open to graduate students and senior English majors. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75.* Murphy

532 Modern Literary Criticism *I, 3*
Dominant modes and schools of criticism exemplified by T. S. Eliot, T. E. Hulme, I. A. Richards, Edmund Wilson, John Crowe Ransom, and other important critics. Pertinent related literary works. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75.* Goldman

535 Old English *I, 3*
Introduction to the language and literature. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Malina and Mensel

536 Problems in Linguistics and Literature *II, 3*
Recent developments in linguistics and their application to the study of literature. *(Lec. 3). Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Titus

540 Modern American Novel *I, 3*
Important American novelists of the twentieth century with emphasis on major developments in ideas and techniques. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Hoffmann, Marshall and Gullason

545 Problems in American Realism and Naturalism *I, 3*
Readings, discussions, and papers on stylistic, thematic, and philosophic issues relating to literary artists like Howells, James, Crane, Dreiser, Hemingway, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Gullason

546 Problems in American Romanticism *II, 3*
Major themes and works of such authors as Poe, Emer-

son, Thoreau, Hawthorne, Melville, Whitman, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Robinson and Collins

547 Early American Literature to 1800 *I, 3*
Thorough examination of colonial and federal literature, some discussion of beginnings of Romanticism. Special attention to Taylor, Edwards, Franklin, Fremeau and Charles Brockden Brown. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1975-76.* Schoonover and Marshall

548 American Poetry to 1900 *I, 3*
Important colonial and nineteenth century American poets with emphasis on major trends in ideas and techniques. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Robinson, Potter and Collins

549 Modern American Poetry *II, 3*
In-depth study of several major American poets, such as Eliot, Pound, Frost, Stevens, Williams, and others; or of a school, such as the Imagists, the Fugitives, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Goldman and Potter

550 Middle English Literature *II, 3*
Selections from Middle English literature exclusive of Chaucer. Works by Malory, the *Pearl*-Poet, Gower, the Wafefield Master, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* MacLaine

551 The Metaphysical Poets *I, 3*
Intensive analysis and interpretation of poetry of Donne, Herbert, Vaughan, Crashaw, and Marvell. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1975-76.* Sorlien

554 Modern British Poetry *I, 3*
In-depth study of several major British poets, such as Yeats, Lawrence, Auden, Thomas, MacNeice, and others; or of a school such as the War Poets (WWI), and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1975-76.* Goldman and Matthews

555 Modern British Novel *I, 3*
Important British novelists of twentieth century with emphasis on major trends in ideas and techniques. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Hoffmann

556 English Liturature of the Sixteenth Century *I, 3*
Early humanism. Tudor poetry and its continental antecedents. Satire and translation. Elizabethan voyage literature. Writers chosen from More, Erasmus, Skelton, Wyatt, Surrey, Sidney, Spenser, Marlow, Hakluyt, Lodge, Shakespeare and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Murphy, Sorlein and Hills

557 English Literature of the Seventeenth Century *II, 3*
Selected poets and prose writers, studied for their contribution to the dominant themes and modes of expression of the Stuart and Cromwellian eras. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Sorlein and Jacobs

558 English Literature of the Eighteenth Century *I, 3*
Intensive study of major and selected minor figures of the eighteenth century. Emphasis on verse and non-fiction prose, some attention to developments of the drama. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Joel, Kunz and Reaves *Not offered 1974.*

559 English Literature of the Romantic Period *II, 3*
Selections from the major works and writers of the Romantic Movement. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Petrie, Seigel and Tutt

560 English Literature of the Victorian Period *II, 3*
Selections from the major works and writers of the Victorian Period. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1975-76.* Goldman and Seigel

561 Modern European Novel *II, 3*
Major developments in European novel during twentieth century. Special attention to Proust, Mann, Kafka, Moravia, Silone, Lagerkvist, Malraux and Camus. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1975-76.* Gullason

570 Anglo-Irish Writers *II, 3*
The Celtic Renaissance as a literary movement, its importance and influence. AE, Lady Gregory, Joyce, O'Casey, O'Flaherty, Stephens, Synge, Yeats, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1975-76.* Murphy

571 Problems in Chaucer *I, 3*
Intensive study of selected aspects of Chaucer's achievement as a poet. Emphasis on *The Canterbury Tales. (Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* MacLaine, Malina, Mensel and Neuse

572 Spenser *I, 3*
The major poetry, with special emphasis on *The Faerie Queen. (Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75.* Neuse

573 Problems in Shakespeare *II, 3*
Primarily a discussion course, concentrating on plays and characters that offer most interesting problems for student analysis. Solutions by leading critics are examined. *(Lec. 3) Prerequisite: permission of instructor.* Smith

574 The Scots' Poetic Tradition through Robert Burns *I, 3*
Intensive study of the poetry of Robert Burns, Fergu-son, Ramsay, and others who sparked the Scottish revival. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1976-77. Not offered 1974.* MacLaine

575 Modern Southern Literary Renaissance *II, 3*
Comprehensive study of a major literary movement. Representative works by Faulkner, Wolfe, Warren, Williams, Porter, Welty, O'Connor, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Gullason

576 English Novel of the Eighteenth Century *I, 3*
Selected novels of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen, with consideration of major criticism and of disparate influences on the emergence of the novel. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1975-76.* Joel and Kunz

577 English Novel of the Nineteenth Century *I, 3*
Important British novelists of the nineteenth century with emphasis on trends in ideas and techniques of Victorian novelists. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Hoffmann, McCabe and Seigel

578 Problems in Milton *II, 3*
Emphasis on the major poetic works. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Neuse

590 Selected Topics *I and II, 3*
Selected topics in American and British literature, and topics of special interest not covered by traditional department offerings. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. Fall, 1975: Human Love — Wyatt to Donne,* Sorlein. *Spring, 1975: American Short Stories of the 1920's,* Gullason

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

631 Seminar in Old English *II, 3*
Advanced readings in Old English literature. *(Lec. 3) Prerequisite: ENG 535. In alternate years, next offered 1974-75.* Malina and Mensel

Courses 640 through 661 are lectures, discussions, extensive readings, individual research, and a substantial research paper. (Lec. 3) Prerequisite: permission of department.

640, 641 Seminar in American Literature before 1900 *I and II, 3 each*
Fall, 1975: Howells and Twain, Gullason. *Spring, 1976: Hawthorne,* Robinson.

642, 643 Seminar in Modern Literature (American) *I and II, 3 each*
Fall, 1974: Fitzgerald and Hemingway, Hoffmann. *Spring, 1976: Steinbeck,* Gullason.

650, 651 Seminar in English Literature of the Middle Ages *I and II, 3 each*
Spring, 1975: Medieval Romance, Neuse

652, 653 Seminar in English Literature of the Sixteenth Century *I and II, 3 each*
Fall, 1974: Renaissance Humanism, Murphy *Spring, 1976: Shakespeare's Romances,* Murphy. *Fall, 1975: The New Testament in the Elizabethan Age,* Hills

654, 655 Seminar in English Literature of the Seventeenth Century *I and II, 3 each*
Fall, 1974: Art and Literature, Jacobs. *Spring, 1975: Donne,* Sorlein

656, 657 Seminar in English Literature of the Eighteenth Century *I and II, 3 each*
Fall, 1974: Defoe and Swift, Reaves. *Spring, 1975: Burns,* McLaine. *Spring, 1976: Tristram Shandy and its Sources,* Joel

658, 659 Seminar in English Literature of the Nineteenth Century *I and II, 3 each*
Fall, 1974: Carlyle, Seigel. *Fall, 1975: Novels of Dickens,* Seigel

660, 661 Seminar in Modern Literature (English) *I and II, 3 each*
Spring, 1975: Annus Mirabilis: 1922, Hoffmann

691, 692 Special Problems *I and II, 3 each*
Advanced study of an approved topic, under the supervision of a member of the staff. *(Lec. 3) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

EXPERIMENTAL STATISTICS (EST)

408 or 409 Statistical Methods in Research I *I and II, 3*

412 Statistical Methods in Research II *II, 3*

413 Data Analysis *II, 3*

491, 492 Problems in Experimental Statistics *I and II, 1-3 each*

500 Nonparametric Statistical Methods *II, 3*
Rank and sign tests, permutation tests and randomization, run test, tests of goodness of fit, order statistics,

estimation, and comparison with parametric procedures. Examples illustrating the applications of non-parametric techniques. *(Lec. 3) Prerequisite: EST 408 or 409.* Lawing and Hanumara

511 Linear Statistical Models *I, 3*
Review of mathematical and statistical concepts. Multivariate normal distribution. Distribution of quadratic forms. Power of the F-test. Basic linear models: general linear hypothesis, regression models, experimental design models, variance component models, mixed models. *(Lec. 3) Prerequisite: MTH 215 and EST 412 or MTH 452.* Carney

520 Fundamentals of Sampling and Applications *II, 3*
Simple random sampling; properties of estimates, confidence limits. Sample size. Stratified random sampling; optimum allocation, effects of errors, and quota sampling. Regression and ratio estimates; systematic and multi-stage sampling. *(Lec. 3) Prerequisite: EST 408 or 409.* Carney and Hanumara

532 (or ASC 532 or PSY 532) Experimental Design *I or II, 3*
Application of statistical methods to biological and psychological research and experimentation. Experimental situations for which various ANOVA and ANCOVA designs are most suitable. *(Lec. 3) Prerequisite: EST 408 or 409 or equivalent.* Archer or Smith

541 Multivariate Statistical Methods *I, 3*
Review of matrix analysis. Multivariate normal distribution. Tests of hypotheses on means, Hotelling's T^2, discriminate functions. Multivariate regression analysis Canonical correlations. Principal components. Factor analysis. *(Lec. 3) Prerequisite: EST 412 or PSY 510.* Hanumara and Hemmerle

550 Ecological Statistics *I, 3*
Application of statistical methodology to the following topics: population growth, interactions of populations, sampling and modelling of ecological populations, spatial patterns, species abundance relations, and ecological diversity and measurement. *(Lec. 3) Prerequisite: EST 409 or permission of instructor.* Staff

576 Econometrics I
See Resource Economics 576.

577 Econometrics II
See Resource Economics 577.

584 Pattern Recognition
See Electrical Engineering 584.

591, 592 Problems in Experimental Statistics *I and II, 1-3 each*
Advanced work in experimental statistics. Conducted as seminars or as supervised individual topics. *Prerequisite: permission of department.* Staff.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

610 Factor Analysis
See Psychology 610.

635 Response Surfaces and Evolutionary Operations
See Industrial Engineering 635.

FINANCE (FIN)

410 Capital Markets *I and II, 3*

415 Liquidity Management *I, 3*

416 Intermediate Financial Management *II, 3*

433 Bank Financial Management *I, 3*

440 Problems of Portfolio Mangagement *II, 3*

452 International Financial Management *II, 3*

491, 492 Directed Study *I and II, 3 each*

540 Theory of Finance *I and II, 2*
Uses of financial instruments, problems of capital financing, financial expansion and reorganization, operations of specialized financial institutions. *(Lec. 2) Prerequisite: ACC 510, MGS 580.* Staff

641 Advanced Financial Theory *I and II, 3*
Role of the financial manager in analysis, profit planning and control activities. Emphasis on goals, basic concepts and tools of decision making as applied to working capital management, capital budgeting and capital structure decisions. *(Lec. 3) Prerequisite: FIN 540.* Staff

645 (OMR 632) Managerial Economics *I and II, 3*
The applications of economic theory and methodology to business problems. *(Lec. 3) Prerequisite: all foundation courses.* Booth

648 Financial Cases and Readings *I and II, 3*
Problems and decisions as to the management of funds. Case method used. *(Lec. 3) Prerequisite: FIN 641.* Staff

649 Seminar in Finance *I and II, 3*
Independent research. Individual topics based on readings and research interests of the students. *(Lec. 3) Prerequisite: FIN 641.* Staff

FISHERIES AND MARINE TECHNOLOGY (FMT)

416 Marine Transportation *II, 3*

452 Industrial Fishery Technology *II, 3*

FOOD AND NUTRITIONAL SCIENCE (FNS)

401, 402 Special Problems *I and II, 2-4 each*

438 Experimental Food Science *II, 3*

441 Advanced Human Nutrition *I, 3*

444 Nutrition and Disease *II, 3*

445 Readings and Reports in Nutrition *II, 3*

502 Advanced Experimental Foods *II, 3*
Application of the principles of food science and technology in the development of food products, considering effective methods of preparation, processing and preservation, and the control and evaluation of food product quality. *(Lab. 6) Prerequisite: permission of department.* Staff.

503 Nutrition Research Methods *I, 3*
Comprehensive study of literature. Practice in techniques and methods as applied to animal and human nutrition research. *(Lec. 1, Lab. 4) Prerequisite: permission of department.* Staff

505, 506 Marine Foods Seminar *I and II, 1 each*
Study of current problems of marine foods such as those concerned with the resource, supply, health safety, nutritive value, preservation and consumer acceptability. Participation by students, faculty, and visiting lecturers. *(Lec. 1) Prerequisite: permission of department.* Staff

511, 512 (504) Food Science and Nutrition Seminar *I and II, 1 each*
Studies and discussions of recent research and other significant developments in the field. Oral and written presentation of papers on selected topics or on individual research. *(Lec. 1) Graduate students must earn a total of 2 credits. Prerequisite: graduate standing or permission of department.* Staff

531 Teaching of Nutrition
See Education 531.

591, 592 Special Research Problems *I and II, 2-4 each*
Advanced work under supervision of staff member. Arranged to suit individual requirements of students. *Prerequisite: permission of department. For graduate students only.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOOD AND RESOURCE CHEMISTRY (FRC)

411 (or PLS 411) Soil Chemistry and Fertilizers *I, 3*

412 (or PLS 412) Soil Biochemistry *II, 3*

431 Biochemistry of Foods *I, 3*

432 Biochemistry of Food Processing *II, 3*

452 Plant Biochemistry *II, 3*

491, 492 Special Projects *I and II, 3 each*

501, 502 Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to Food and Resource Chemistry. Staff

521 Pesticide Chemistry *I, 3*
Nomenclature, chemical and physical properties, mode of action, and methods of analysis of insecticides, fungicides and herbicides. *(Lec. 2, Lab. 3) Prerequisite: organic chemistry.* Olney

526 (or MCH 526) Lipid Chemistry *II, 3*
Advanced course in the chemistry of biologically important lipids such as the fatty acids, neutral glycerides, phospholipids, steroids, and the chemistry and biochemistry of the carotenoids. *(Lec. 3) Prerequisite: BCH 581.* Olney, J. G. Quinn, Simpson, and Turcotte

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

691, 692 Research in Food and Resource Chemistry *I and II, 3 each*
Assigned research on an advanced level. Student is required to outline problem, conduct the necessary literature survey and experimental work, and to present his observations and conclusions in a report. Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOREST AND WILDLIFE MANAGEMENT (FOR)

401 Forest Influences *I, 3*

402 Wildlife Populations *II, 3*

421 The Wetland Environment *I, 3*

491, 492 Special Projects *I and II, 1-3 each*

FRENCH (FRN)

402 French Phonetics *II, 3*

411 Medieval French Literature *I, 3*

422 French Literature of the Renaissance *II, 3*

431, 432 French Literature of the Seventeenth Century *I and II, 3 each*

441, 442 French Literature of the Eighteenth Century *I and II, 3 each*

451 Romanticism *I, 3*

452 Realism and Symbolism *II, 3*

461 Drama of the Twentieth Century *I, 3*

462 Poetry of the Twentieth Century *II, 3*

463 Twentieth-Century Prose through 1950 *I, 3*

464 Twentieth-Century Prose since 1950 *II, 3*

471 Black French Prose and Poetry *I or II, 3*

472 Black French Theater *II, 3*

497, 498 Directed Study *I and II, 3 each*

501 Advanced Composition *I, 3*
Stylistics to prepare undergraduate and graduate majors to write expository French prose. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

502 Stylistics *II, 3*
Emphasis on acquisition of ability to write at length in an acceptable literary style. Each student prepares a study of monograph length on an appropriate subject. *(Lec. 3) Prerequisite: FRN 501 or equivalent.* Porter

503, 504 History of the French Language *I and II, 3 each*
Linguistic development of French from the *Serments de Strasbourg* to the end of the Middle Ages. Particular attention to sound and form changes. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

511, 512 French Literature of the Middle Ages *I and II, 3 each*
Intensive study of French literature in the medieval period. Reading of selected texts and discussion of the literary values of Old French. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

521 The French Renaissance *I, 3*
Examination of the origins and development of the Renaissance in France as seen in the writings of Rabelais and the poets of his time. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Benson

522 The Rise of Introspective Writings in Sixteenth Century France *II, 3*
Thematic study of self-analysis as practiced by Montaigne and his contemporaries. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Benson

531 The Tragic Theater of the Seventeenth Century *I, 3*
French tragic theater in the seventeenth century, with particular attention to the works and influence of Corneille and Racine. *(Lec. 3) Prerequisie: graduate status or permission of instructor.* Morello

532 The Comic Theater of the Seventeenth Century *II, 3*
French comic theater of the seventeenth century, with particular attention to the works and influence of Molière. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Morello

541 The Age of Enlightenment *II, 3*
Intellectual trends in seventeenth-century French literature as it relates to the important eighteenth century philosophical production of Montesquieu, Voltaire, Buffon, Diderot and others. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Rothschild

542 The Theater of the Eighteenth Century *I, 3*
Theater of the eighteenth century, with emphasis on the dramatic works of Regnard, LeSage, Marivaux, Voltaire and Beaumarchais. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Rothschild

543 The Novel of the Seventeenth and Eighteenth Centuries *I, 3*
Evolution of the French novel, with emphasis on writers such as D'Urfé, Scarron, Mme. de Lafayette, LeSage, Marivaux, Prévost, Voltaire and Diderot. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Rothschild

551 The Romantic Movement *I, 3*
Detailed study of the chief proponents of the movement: Chateaubriand, Mme. de Staël, Constant, Lamartine, Hugo, Vigny, Musset, Sand *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.* Toloudis

552 Realism and Naturalism *I, 3*
French Realism and Naturalism: Balzac, Flaubert, Zola, de Maupassant, the Goncourt *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.* Chartier

553 The Symbolist Movement *I, 3*
Intensive study of poetry of Baudelaire, Verlaine, Rimbaud, Mallarmé and of their sources and influence. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Chartier

561 Contemporary French Theater through 1950 *I and II, 3*
Survey of important dramatists and *metteurs en scène* from Symbolism and Realism through 1950. *(Lec. 3)*

Prerequisite: graduate status or permission of instructor. Waters

562 French Theater since 1950 *II, 3*
Emphasis on recent developments such as the theater of the absurd and social theater. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Waters

563 The Novel of the Twentieth Century *I, 3*
Intensive study of major novelists with emphasis on trends in philosophies and in techniques as illustrated by such authors as Gide, Mauriac, Malraux, Saint-Exupéry, Sartre Camus, *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.* Toloudis

591 Proust and Claudel *II, 3*
Analysis and interpretation of the imaginative writings of Proust and Caludel. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Waters

594 Special Problems *I and II, 3*
Group and/or individual investigation of special problems in French literature. Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

901, 902 Reading Course in French for Graduate Students *I and II, 0*
901: Fundamentals of grammar and syntax necessary to develop reading knowledge. Assumes no prior knowledge of French. *FRN 902:* Exercises in reading scholarly and scientific texts. Hyland

GENERAL BUSINESS ADMINISTRATION (GBA)

671 Methods of Business Research *I and II, 3*
An understanding of research methodology and the culmination of such methodology into a term project. *(Lec. 3) Prerequisite: MGS 581 or equivalent and permission of department.* Hellman, Hill

691 Directed Study in Administration *I and II, 1-3*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. 1-3) Prerequisite: permission of M.B.A. director.* Staff

GENETICS

Animal Science
470 Population Genetics

Botany
554 Cytogenetics
579 Advanced Genetics Seminar

Microbiology
552 Microbial Genetics

Plant and Soil Science
472 Plant Improvement

Zoology
475 Causes of Evolution
476 Human Genetics
518 Mechanisms of Development
573 Developmental Genetics
576 Ecological Genetics
579 Advanced Genetics Seminar

GEOGRAPHY (GEG)

403 Meteorology and Climatology I *I, 3*

404 Meteorology and Climatology II *II, 3*

405 Introduction to Synoptic Meteorology and Climatology *I, 3*

406 Microclimatology *II, 3*

411 Urban Geography *I, 3*

421 Introductory Cartography *I, 3*

422 Advanced Cartography *II, 3*

432 Seminar in Political Geography *II, 3*

441 Geography of Europe *II, 3*

442 Geography of the Soviet Union *I, 3*

443 Geography of the United States and Canada *II, 3*

444 Geography of the Middle East and the Indian Subcontinent *II, 3*

446 Geography of the Polar Regions *II, 3*

447 Southeast Asia and Oceania *II, 3*

452 Transportation Geography *II, 3*

481 History and Philosophy of Geography *I, 3*

482 Quantitative Methods in Geography *I, 3*

491, 492 Special Problems in Geography *I and II, 3 each*

502 Research Methods in Geography *I, 3*
Fundamentals of geographic research, including techniques of field observation and interpretation, and the introduction to the use of the Computer Laboratory and computer package program. *(Lec. 3) Prerequisite: GEG 482 or permission of department.* Capelle

512 (412) Seminar in Urban Geography *I, 3*
Urban patterns, their development, sizes, spacing, structure, and relationship to the global urban network. The urban environment as a context for geographic studies. *(Lec. 3) Prerequisite: GEG 100 or permission of department. In alternate years, next offered 1975-76.* Higbee

526 Plant Geography
See Botany 526.

542 Seminar in Economic Geography *II, 3*
Analytical approaches to rational utilization of the world's resources. Emphasis on agricultural and industrial location theory, diffusion of ideas and innovations, and recreational analysis *(Lec. 3) Prerequisite: permission of department.* Capelle

543 Geography of Megalopolis *II, 3*
Analysis of northeastern seaboard of the United States in terms of its physical and economic foundations, its distinctiveness as a region, key role the analysis of Megalopolis plays in understanding incipient major conurbations in the United States and the world. *(Lec. 3) Prerequisite: GEG 443 or permission of department. In alternate years, next offered 1975-76.* Higbee

545 Geography of the North Atlantic Basic *II, 3*
Description and analysis of the North Atlantic Ocean and its borderlands, including northeastern North America, western littoral of Europe. Emphasis on orientation to, and use of, the marine environment, the role of the North Atlantic as a uniting and divisive force in the western community. *(Lec. 3) Prerequisite: GEG 131 or permission of department.* Alexander

551 (451) Land Utilization *I, 3*
Physical differences in land quality and the various functions of land in the modern community. Consideration given to the principles of land planning for effective use and conservation in rural and urban areas. *(Lec. 3) Prerequisite: ESC 104. In alternate years, next offered 1974-75.* Higbee

571 Marine Geography *I, 3*
The marine region as a unique complex of physical and cultural elements. The purpose is to analyze functional relationships within the region and to assess forms of regional organization and control. *(Lec. 3) Prerequisite: permission of department.* Alexander

591, 592 Directed Study or Research *I and II, 3*
Areas of special research interests of graduate students. *(Lec. 3) Prerequisite: permission of department.* Staff

595 Problems of Modernization in Developing Nations
See Resource Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

GEOLOGY (GEL)

410 Geomorphology *I, 4*

420 Mineralogy *I, 4*

421 Optical Mineralogy *II, 4*

425 Principles of Geochemistry *I, 3*

430 Petrology *II, 4*

440 Introduction to Paleontology *I, 4*

450 Introduction to Stratigraphy and Sedimentation *I, 4*

465 Introduction to Geophysics *I, 3*

470 Structural Geology *II, 4*

510 Coastal Geomorphology *II, 3*
Coastal development and interpretation in relation to endogenetic and exogenetic shore processes. Experimental model wave tank studies and applied field studies. *(Lec. 3) Prerequisite: GEL 410, 450, or permission of instructor. Offered in spring of odd calendar years.* Fisher

526 Igneous and Metamorphic Geochemistry *II, 3*
Applications of elementary thermodynamics to geologic problems including phase equilibria and igneous and metamorphic reactions. Incorporates the classical approach and a survey of the current literature in the area of geochemical petrology. *(Lec. 3) Prerequisite: GEL 425, MTH 142 or permission of instructor. Offered in spring of odd calendar years.* Hermes

530 Igneous Petrology *I, 3*
Tectonic and chemical bases for igneous phenomena stressing the association concept of igneous activity. Evaluation of the criteria used in petrogenetic interpretations. *(Lec. 2, Lab. 3) Prerequisite: GEL 430 or permission of instructor. Offered in fall of odd calendar years.* Cain

531 Metamorphic Petrology *II, 3*
Facies concept and other methods of interpreting metamorphic mineral assemblages. Chemical and fabric changes during metamorphism, including principles of structural petrology. *(Lec. 2, Lab. 3) Prerequisite: GEL*

430 or permission of instructor. Offered in spring of even calendar years. Cain

541 Animal Micropaleontology *II, 3*
Concentrated study of animal microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. *(Lec. 2, Lab. 3) Prerequisite: GEL 440 or permission of instructor. Offered in spring of even calendar years.* Tynan

542 Plant Micropaleontology *I, 3*
Concentrated study of plant microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. *(Lec. 2, Lab. 3) Prerequisite: GEL 541 and BOT 111, or permission of instructor. Offered in fall of even calendar years.* Tynan

550 Sedimentation *I, 3*
Physical and chemical processes of sedimentation, including weathering, erosion, transportation, deposition, and diagenesis. Laboratory application of theory, with independent project and reading. *(Lec. 2, Lab. 3) Prerequisite: GEL 450 or permission of instructor. Offered in fall of even calendar years.* Hampton

551 Sedimentary Petrology *II, 3*
Characteristics of sediments and sedimentary rocks as a function of the environments of source, transportation, deposition, and diagenesis. *(Lec. 2, Lab. 3) Prerequisite: GEL 550 or permission of instructor. Offered in spring of odd calendar years.* Hampton

555 Stratigraphy *II, 3*
Principles and methods used to analyze and interpret areal and time relationships of stratified rocks and history of life contained in the rocks. *(Lec. 2, Lab. 3) Prerequisite: GEL 440 and GEL 450 or permission of instructor. Offered in spring of odd calendar years.* Tynan

561 Evaluation of Geologic Data *I, 3*
Quantification of geologic data including methods and limitations of quantification. Development and evaluation of concepts of sampling, accuracy, precision, and hypothesis and model formulation. Sources, types, and degrees of error in sampling, measuring, presenting geologic data. *(Lec. 3) Prerequisite: two 400-level courses in geology and EST 411 or equivalent, or permission of instructor. Offered in fall of even calendar years.* Cain

565 Advanced Interpretation in Applied Geophysics *II, 3*
Interpretation of geophysical data using theoretical models. Reflection, refraction and surface propagation of seismic energy. Computer analysis of gravity and magnetic potential data. D.C. geoelectrical potential over horizontally stratified medium. *(Lec. 2, Lab. 2) Prerequisite: MTH 243, PHY 214, GEL 465 or equivalent course in physics with permission of instructor. Offered in spring of even calendar years.* Frohlich

566 Seismology and Plate Tectonics *II, 3*
Earthquakes, intensity and magnitude determination, fault plane solution; earth's interior, crustal and upper mantle structure related to plate boundaries. Seismic zones and margins of tectonic plates. Earthquake control and prediction. *(Lec. 2, Lab. 3) Prerequisite: MTH 142, PHY 214, GEL 465, or equivalent course in physics or mathematics with permission of instructor. Offered in spring of odd calendar years.* Frohlich

581 (or OCE 581) Coastal Engineering Geology *II, 3*
Interaction of geological factors and coastal structures. Shore materials, energy-material relationships, interference of man-made structures with the natural regimen emphasized. *(Lec. 3) Prerequisite: GEL 302 or 410 and 450, or OCG 540 or permission of instructor. Offered in spring of even calendar years.* Fisher

585 Geohydrology *I, 3*
Ground-water hydrology and drainage basin analysis related to geomorphology, glacial geology and sedimentology. Analysis of water resources in various geologic environments. Geophysical methods of investigation. *(Lec. 3) Prerequisite: GEL 302 or 410 and 450 and permission of instructor. Offered in fall of odd calendar years.* Fisher

590 Special Problems *I and II, 1-3*
Advanced work under the supervision of a member of the staff arranged to suit the individual requirements of the student. *(Lec. and/or Lab. according to the nature of the problem.) Prerequisite: permission of instructor.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: For other related courses see PHY 522 and OCG 540, 630, 631, 643, 644, 645, 647.

GERMAN (GER)

409 History of the German Language *I, 3*

431 German Literature from 800 to 1700 *II, 3*

441, 442 German Literature of the Eighteenth Century *I and II, 3 each*

451, 452 German Literature of the Nineteenth Century *I and II, 3 each*

485, 486 Special Studies *I and II, 3 each*

497, 498 Directed Study *I and II, 3 each*

901, 902 Reading Course in German for Graduate Students *I and II, 0*
901: Fundamentals of grammar and syntax necessary to

develop reading knowledge. Assumes no prior knowledge of German. *902:* Exercises in reading scholarly and scientific texts. Staff

HISTORY (HIS)

405 Western Europe in the High Middle Ages *I, 3*

406 The Renaissance *II, 3*

408 History of Europe, 1648-1789 *I, 3*

409 The French Revolution and Napoleon *I, 3*

410 History of Europe, 1815-1914 *I, 3*

411 History of Europe since 1914 *II, 3*

426 German History, 1640-1871 *I, 3*

432 History of Russia to 1917 *I, 3*

469 The Protestant and Catholic Reformation I *I, 3*

470 The Protestant and Catholic Reformation II *II, 3*

471 History of the Far East: Classical Period *I, 3*

472 History of the Far East: Modern Period *II, 3*

473 History of Modern China *II, 3*

474 History of Modern Japan *I, 3*

493, 494 Topics in History *I and II, 3 each*

501 Colloquium in European History *I or II, 3*
Intensive study of major interpretative works in European history. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

502, 503 Special Readings in European History *I and II, 3 each*
Intensive tutorial work, research and readings in European history. *Prerequisite: graduate standing and permission of instructor. Concurrent audit of parallel 300-level course required. May be repeated.* Staff

515 Seminar in Twentieth-Century Diplomacy *II, 3*
Research in the history of international relations since 1900. *(Lec. 3) Prerequisite: HIS 410 or 411 or permission of department. In alternate years.* Schach

521, 522 Readings and Research in European History *I and II, 3 each*
Intensive study of selected topics in European history. With permission of the department, this course may be taken twice for credit. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

535 Colloquium in American History *I or II, 3*
Intensive study of major interpretative works in American history. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

536, 537 Special Readings in American History *I and II, 3 each*
Intensive tutorial work, research and readings in American history. *Prerequisite: graduate standing and permission of instructor. Concurrent audit of parallel 300-level course required. May be repeated.* Staff

540 Seminar in American Colonial History: The Seventeenth and Eighteenth Centuries *I or II, 3*
Intensive research on selected topics in the Colonial period of American history. *(Lec. 3) Prerequisite: permission of department.* Staff

541 Seminar in Nineteenth-Century American History *I and II, 3*
Intensive research on selected topics in the broad period between adoption of the Constitution and World War I. *(Lec. 3) Prerequisite: permission of department.* Staff

542 Seminar in Twentieth-Century United States History *I and II, 3*
Intensive research on selected topics in United States history since 1900. *(Lec. 3) Prerequisite: permission of department.* Staff

543 Seminar in the History of the United States, Foreign Relations *II, 3*
Research in the history of U.S. foreign relations since 1775. All aspects of foreign relations, including both internal and external factors and historiographical problems will be considered. *(Lec. 3) Prerequisite: HIS 452 or permission of department.* Castigliola

550 Seminar in Black Nationalism and the International Race Problem *I or II, 3*
Examination of the historical roots of black nationalism in the United States and the international implications of racial conflicts in selected areas of the world. *(Lec. 3) Prerequisite: permission of instructor.* Weisbord

560 Research in Local History *II, 3*
Directed research in secondary and primary materials on topics of interest to the individual. *(Lec. 3) Prerequisite: HIS 141 and 142.* Metz

580 Colloquium in Latin-American History *I or II, 3*
Intensive study of major interpretative works in Latin-American history. *(Lec. 3)* Bryan

588, 589 Special Readings in Third World History *I and II, 3 each*
Intensive tutorial work, research and readings in Third World history. *Prerequisite: graduate standing and per-*

mission of instructor. Concurrent audit of parallel 300-level course required. May be repeated. Staff

591 Directed Study or Research *I and II, 3*
Directed readings, research, or study designed to meet the particular needs of individuals or small groups of graduate students. Staff

593 Seminar in Historical Studies *I and II, 3*
Advanced study in the major literature of American or European history. Emphasis placed upon problems of historiography and historical criticism. *(Lec. 3) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

HOME MANAGEMENT (HMG)

401 Home Management Problems of Deprived Families *II, 3*

470 Special Problems in Home Management *I and II, 2-4*

570 Special Problems in Home Management *I, 3*
Advanced study to be selected from areas of home management theory and its application, work simplification, family economics and equipment. *(Lab. TBA)* Staff

575 Presentation of Home Management Principles *II, 3*
Special problems in presenting principles of home management at the secondary level, the college level, and in adult education. *(Lec. 3)* Staff

INDUSTRIAL ENGINEERING (IDE)

404 Engineering Economy *I, 3*

411 Engineering Statistics I *I, 3*

412 Engineering Statistics II *II, 3*

422 Production Facilities Design *II, 3*

430 Design and Analysis of Compensation Systems *II, 3*

432 Operations Research I *I, 3*

433 Operations Research II *II, 3*

440 Materials Processing and Metrology I *II, 3*

491, 492 Special Problems *I and II, 1-6 each*

500 Network Application in Industrial Engineering *II, 3*
Industrial system problems that can be formulated in terms of flows in networks. Critical path scheduling, transportation problems, allocation, sequencing, line balancing, etc. *(Lec. 3) Prerequisite: IDE 432 and permission of instructor. In alternate years.* Shao

510 Human Factors *II, 3*
Analytic relationships between man and his working environment. Design of equipment, facilities and environmental controls to meet the capabilities and limitations of the human being. *(Lec. 3) Prerequisite: permission of instructor.* Rubinsky

513 Statistical Quality Control *I, 3*
Topics in statistical quality control systems. Single, multiple, and sequential sampling. Design and analysis of a wide variety of statistical control systems used in conjunction with discrete and continuous data, for several kinds of data emission. *(Lec. 3) Prerequisite: IDE 412 or equivalent.* Nichols

517 Applied Control Theory in Industrial Engineering *I, 3*
Complex control mechanisms will be studied and applied to production and manufacturing operation. Automatic control systems for production and manufacturing will be designed and analyzed. *(Lec. 3) Prerequisite: IDE 404, MTH 244 and permission of instructor.* Staff

520 Material Handling *I, 3*
Development of principles for engineering design and evaluation of equipment to move industrial materials in and between processes, including chemical and physical characteristics of material to be handled, rates of material flow, queuing and economics. *(Lec. 3) Prerequisite: MCE 263, CVE 220, IDE 404.* Rubinsky

525 Simulation
See Computer Science 525.

533 Advanced Statistical Methods for Research and Industry *I, 3*
Estimation and testing; regression and correlation; analysis of variance and related topics. Applications in industrial operations and engineering research. *(Lec. 3) Prerequisite: IDE 411 or permission of instructor.* James

535 Industrial Reliability Engineering *II, 3*
Theories of reliability applicable to the design and operations of manufacturing processes and product quality assurance control systems. Quantitative analyses of economic specifications, performance levels, maintenance levels, and redundancy systems. *(Lec. 3) Prerequisite: permission of instructor.* Nichols

540 Production Control and Inventory Systems *I, 3*
Theory and practice of industrial production control and inventory systems. A broad spectrum of mathematical models for static, dynamic, perpetual, and periodic inventory systems as they affect and relate to production. *(Lec. 3) Prerequisite: permission of instructor.* Staff

541 Materials Processing and Metrology II *I, 3*
Continuation of IDE 440. Engineering analyses in the processing of materials. Dynamic coupling, tool-workpiece interaction, energy and thermal analysis; mechanics of material removal and displacements, advanced topics in mechanical electrical systems for processing of materials. *(Lec. 3) Prerequisite: IDE 440 or permission of instructor.* Staff

550, 551 Advanced Topics in Probabilistic Operations Research I and II *I and II, 3 each*
Concepts of simple random processes and their application in the analysis of industrial problems. Random walk, branching processes, recurrent events, discrete and continuous Markov chains, birth and death models and their application to inventory, replacement, reliability, and waiting line problems. *(Lec. 3) Prerequisite: IDE 411, MTH 215, or equivalent.* Branson

555, 556 Engineering Applications of Mathematical Programming I and II *I and II, 3 each*
Sensitivity analysis and pricing problems, practical problems in degeneracy and duality, decomposition methods for large-scale systems, applied convex, integer, nonlinear and quadratic programming methods. An introduction to stochastic programming. *(Lec. 3) Prerequisite for 555: IDE 432 and permission of instructor. Prerequisite for 556: IDE 555 and permission of instructor. In alternate years.* Staff

560 Process Engineering *II, 3*
Design and selection of processes, equipment, instrumentation and production sequence for efficient and economic manufacture of products through mathematical analyses of physical and economic principles. *(Lec. 3) Prerequisite: IDE 330, 404.* Staff

565 Theory of Scheduling *II, 3*
Sequencing problems, finite sequencing for a single machine, n/m job shop problems with analytical and heuristic procedures, networks applied to scheduling, queuing systems in scheduling, probabilistic scheduling problems. Survey of selected literature. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1975-76.* Shao

591, 592 Special Problems *I and II, 1-6 each*
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to the nature of the problem) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

610 Topics in Applied Queuing Theory *I, 3*
Poisson and Erlang queues, imbedded chains, M/G/1 and G/M/1 queues, and related topics in queuing theory. Analysis of a wide variety of queues with an applications orientation. *(Lec. 3) Prerequisite: IDE 433 or permission of instructor. In alternate years, next offered 1975-76.* Branson

634 Design and Analysis of Industrial Experiments *II, 3*
Further development of topics in analysis of variance. Randomized blocks, Latin squares and related designs, factorial experiments, confounding and fractional replications, and split-plot designs. Design and analyses of engineering experiments. *(Lec. 3) Prerequisite: IDE 533.* Lawing

635 (or EST 635) Response Surfaces and Evolutionary Operations *II, 3*
Methods of determining the response surface for multiple factors over a specified range and techniques for seeking an optimum. First and second order response surfaces. Rotatable second order design. Central composite rotatable designs. Multivariable EVOP programs and other topics in evolutionary operations. *(Lec. 3) Prerequisite: IDE 533 or equivalent.* Lawing

641 Molecular Aspects of Materials Processing
See Chemical Engineering 637.

642, 643 Advanced Topics in the Processing of Materials I, II *I or II, 3 each*
Extensive studies of contemporary and classical research in material processing. Systems study of problems of processing modern materials and technological achievements in processing. *642:* Metallic materials. *643:* Nonmetallic materials. *(Lec. 3) Prerequisite: IDE 541 or permission of instructor. In alternate years, next offered 1975-76.* Staff

645 Manufacturing Engineering: Design, Analysis, Synthesis *II, 4*
Production and logistic systems, quantitative models introduced in and applied to congestion problems, industrial planning, behavioral theory, control, scheduling, other problem areas of the industrial enterprise. *(Lec. 4) Prerequisite: permission of instructor.* Staff

657 Geometric and Dynamic Programming *II, 3*
Basic concepts of geometric programming, the duality theorem, approximation and limiting techniques. Nature of dynamic programming, deterministic and stochastic sequential decision problems. Lagrange multipliers in both geometric and dynamic programming. *(Lec. 3) Prerequisite: IDE 555. In alternate years, next offered 1975-76.* Shao

660 Methods of Optimization *II, 3*
Methods of optimization: indirect, direct elimination,

climbing. Geometric programming. Problems and other topics in applied optimization. *(Lec. 3) Prerequisite: CSC 500 and permission of instructor. In alternate years, next offered 1975-76.* Staff

691, 692 Advanced Special Problems in Industrial Engineering *I and II, 1-6 each*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problems) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

INSURANCE (INS)

560 Management of Insurance Enterprises *I, 3*
Functional analysis of the operations and problems of stock and mutual insurance organizations in the life, property, and liability insurance industry. Emphasis is upon legal organization, management and control, and financial management of insurers. *(Lec. 3) Prerequisite: permission of instructor.* Fitzgerald

570 Risk Management *II, 3*
Analysis of nature of risk, the identification, measurement and control of pure risk within firm and society. Teaching methodology includes lectures, group discussion and analysis of case problems. *(Lec. 3) Prerequisite: permission of instructor.* Martin

ITALIAN (ITL)

408 Structure of the Italian Language *I or II, 3*

433 Prose Forms in Italian Literature *I or II, 3*

444 Poetic Forms in Italian Literature *I or II, 3*

453 Literature of the Italian Theater *I or II, 3*

455 Selected Italian Authors *I or II, 3*

465 Topics in Italian Literature *I or II, 3*

481, 482 The Works of Dante Alighieri *I and II, 3*

497, 498 Directed Study *I and II, 3 each*

JOURNALISM (JOR)

400 (440) Opinion and Interpretation in Journalism *I and II, 3*

434 Contemporary Issues in Mass Communication *II, 3*

435 Theory of Communication *I, 3*

436 Fundamentals of Communication Research *II, 3*

438 Governmental and Legal Aspects of Mass Communication *I, 3*

441 International Communications *I, 3*

442 Independent Study and Projects in Mass Communications *I and II, 1-3*

443 Mass Communication Media in Africa *II, 3*

452 Public Relations Principles and Publications *I. 3*

LATIN (LAT)

497, 498 Directed Study *I and II, 3 each*

LIBRARY SCIENCE (LSC)

500 Introduction to Libraries and Librarianship *I and II, 3*
Overview of the field covering the language and literature of librarianship, the history and functions of libraries, the nature of the various types of libraries, the library profession, and library operations. *(Lec. 3)* Bergen and Staff

502 Library Administration *I and II, 3*
Libraries and their governing agencies, scientific management principles, organization and operation of library departments, personnel problems and procedures, budget preparation, statistics, and quarters and planning. *(Lec. 3)* Bohnert or Healey

503 Selection of Library Materials *I and II, 3*
Study of and practice in using the principles involved in the selection of books and nonbook materials for collections of all types of libraries. *(Lec. 3)* Tryon

504 Basic Reference *I and II, 3*
Practical experience in the use of basic reference materials, with readings and discussion of the philosophy and administrative aspects of reference work. *(Lec. 3)* Schneider

505 Cataloging and Classification *I and II, 3*
Introduction to the principles and practice of descriptive and subject cataloging and classification using the Dewey decimal classification and Sears subject headings, with an introduction to the Library of Congress classifi-

cation. Emphasis is on books and book-like materials. *(Lec. 3)* Chin

506 Technical Services *I and II, 3*
Principles and policies employed in the acquisition, organization, conservation, and circulation of book and nonbook materials in libraries of various kinds. *(Lec. 3)* Chin

510 History of Books and Printing *I or II, 3*
Western civilization as affected by the book arts and the extension of culture through the printed book, with stress on literary property and censorship as related to printing and libraries. *(Lec. 3)* Tryon

511 Comparative Librarianship *I and II, 3*
The practice of librarianship in selected countries, including the social, economic, and political factors influencing its development, with consideration of the role of cooperation among international organizations. *(Lec. 3)* Bergen

513 Intellectual Freedom and Censorship *I or II, 3*
Historical development and current status of the concept of intellectual freedom and the restraints that past and present societies have imposed on it. Special attention given the librarian's role in defense of intellectual freedom. *(Lec. 3)* Tryon

514 The Library in Society *I, 3*
Character and function of the library as a social agency, with special attention to the philosophies of contemporary librarianship. *(Lec. 3)* Bergen

515 The Library and the Communication Process *I, 3*
The importance of applying communication theories to the study of librarianship. Basic concepts and models of the communication and information transfer process. *(Lec. 3)* Daniel

516 History of Libraries and Librarianship to the Renaissance *I, 3*
The development of libraries and librarianship within a cultural, social, and economic context, from ancient times to the Renaissance. Western civilization will be emphasized. *(Lec. 3)* Bergen

517 History of Libraries and Librarianship from the Renaissance to the Present *II, 3*
The development of libraries and librarianship within a cultural, social, and economic context, from the Renaissance to the present. Western civilization will be emphasized. *(Lec. 3)* Bergen

520 The School Library *I and II, 3*
The school library in relation to the school curriculum, other community library resources, and extra-curricular needs of the students. Special problems in the selection of materials, budgets, and standards for the library as a materials center with an active part in the teaching function of the school. *(Lec. 3) Prerequisite: LSC 502.* Salvatore

521 Public Library Service *I or II, 3*
Reading on and discussion of the backgrounds, aims, and problems of the American public library, with particular attention to larger unit systems. *(Lec. 3) Prerequisite: LSC 502.* Healey

522 College and University Library Service *I or II, 3*
Philosophic and practical considerations implicit in the functions, organization, and management of college and university libraries as these differ from other types of libraries. *(Lec. 3) Prerequisite: LSC 502.* Tryon

523 Special Library Service *I or II, 3*
Organization, management, and regular and special procedures as they apply to special libraries, with particular emphasis upon standards and planning for space and equipment. *(Lec. 3) Prerequisite: LSC 502.* Bohnert or Chin

526 Automation in Libraries *I or II, 3*
The application of technology and systems analysis to the operation of various types of libraries. *(Lec. 3) Prerequisite: permission of instructor.* Healey

527 Seminar in Library Administration *I and II, 3*
Intensive study of selected problems in important areas of library administration by means of discussion, readings, special lectures, and the presentation of papers based on literature surveys or research. *(Lec. 3) Prerequisite: permission of instructor.* Healey

528 Multi-Media and the Library *I and II, 3*
The role of A-V materials in media centers and other types of libraries. *(Lec. 3) Prerequisite: LSC 520.* Daniel

529 Library Cooperation *II, 3*
Library cooperation including the development of library systems, the role of government in the development of such systems, and the problems inherent in the development of cooperation. *(Lec. 3)* Healey

530 Reading Interests of Children *I or II, 3*
Survey of children's literature, analyzing current trends, the limited-vocabulary book at various levels, and the significance of illustrations for the reading process. Main emphasis on informational books as recreational reading. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

531 Reading Interests of Adolescents *I or II, 3*
Materials of special interest to high school students in school and public libraries, stressing nonfiction but including fiction for the age group and for adults and the responsibility of the library in the drop-out problem. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

532 Reading Interests of Adults *I or II, 3*
Examination of the range and depth of books as a source of appeal to adults with emphasis on reading, annotations, and discussion to develop critical faculties. *(Lec. 3)* Tryon

533 Children's Library Materials *I and II, 3*
Books and related library materials in the area of creative literature for children: history, bibliography, selection, evaluation, and presentation. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

536 Storytelling *I, 3*
Selection, adaptation, and presentation of stories for children of all ages, including attention to sources of materials, planning the story hour, and training and practice in the art of storytelling. *(Lec. 3)* Staff

540 Library Materials in the Humanities *I and II, 3*
Important library resources in the humanities, including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3) Prerequisite: LSC 504.* Schneider

541 Library Materials in the Social Sciences *I and II, 3*
Important library resources in the social sciences, including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3) Prerequisite: LSC 504.* Bergen or Schneider

542 Library Materials in Science and Technology *I and II, 3*
Important resources in science and technology including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3) Prerequisite: LSC 504.* Bohnert or Chin

543 Government Publications *I or II, 3*
Survey of the publishing activities and publications of national, state, and local governments with emphasis on the publications of the United States government. *(Lec. 3) Prerequisite: LSC 504.* Schneider

544 Information Science for Librarians *I or II, 3*
Introduction to information storage and retrieval (analysis, semantics, thesaurus building, and data banks and their implications) as it applies to librarianship. *(Lec. 3)* Bohnert

545 Technical Information Centers *I and II, 3*
Study of centers which provide publication, consultant, and question-answering services, emphasizing the differences between them and technical libraries and professional societies. *(Lec. 3) Prerequisite: permission of instructor.* Bohnert

550 Advanced Cataloging *I or II, 3*
Theory and problems in descriptive and subject cataloging. Comparative analysis of different classification schemes with emphasis on the use of Library of Congress classification and subject headings. Includes organization of non-book materials. *(Lec. 3) Prerequisite: LSC 505.* Chin

560 Research in Librarianship *I or II, 3*
Methods of investigating problems in library science and an introduction to and evaluation of the literature of the field. *(Lec. 3) Prerequisite: permission of instructor.* Bohnert

591, 592, 593 Independent Work *By Appt., 1-3 respectively*
Supervised reading or investigation in areas of special interest to students who obtain written approval for such study prior to registration for the semester for which it is proposed. *Prerequisite: 18 hours of library science with a B average.* Staff

LINGUISTICS (LIN)

409, 410 Introduction to the Study of Language *I and II, 3 each*

431 Applied Linguistics in the Language Laboratory *I, 1*

497, 498 Directed Study *I and II, 3 each*

The following are related, specialized courses in historical linguistics offered in the Departments of English and Languages.

ENG 530, History of the English Language
FRN 503, 504 History of the French Language
GER 409 History of the German Language
ITL 409, 410 History of the Italian Language
SPA 409 History of the Spanish Language

MANAGEMENT SCIENCE (MGS)

445 Managerial Application of Simulation *I, 3*

458 Advanced Production Management *II, 3*

476 Management System Analysis *II, 3*

491, 492 Special Problems *I and II, 3 each*

579 Computing in Management *I, 2*
Computer concepts and programming in a high level language such as BASIC, FORTRAN, PL/1. Assigned problems emphasize the use of computing as an administrative and analytical tool for applications in management. *(Lec. 2)* Staff

580 Quantitative Methods for Management Analysis *I, 3*
Mathematical tools useful to managers. Depth coverage given to differential and integral calculus, vectors and matrices. *(Lec. 3)* Staff

581 Management Statistics *II, 3*
Statistical methods as tools of management; the collection and interpretation of data; statistical inference and

decision-making; regression and correlation. *(Lec. 3)* Staff

585 Production and Operations Management *II, 2*
Concepts and problems associated with the design and development of systems for the creation of products and services. *(Lec. 2)* Staff

601, 602 Advanced Management Statistics *I and II, 3 each*
Theory and application of regression and correlation analysis, analysis of variance and experimental design, and other multivariate data analyses. *(Lec. 3) Prerequisite: MGS 581 or permission of instructor.* Mojena, Shen

663 Management Information Systems *II, 3*
Concepts and problems associated with the design, implementation, and management of information systems. *(Lec. 3) Prerequisite: MGS 579 or equivalent or permission of instructor.* Zartler

681 Advanced Operations Management *I, 3*
Problems facing the manager of production and other business processes which are devoted to the creation of capital as well as consumer goods and services are examined and analyzed, employing modern decision-making techniques. *(Lec. 3) Prerequisite: MGS 581 and 585 or permission of instructor.* Parsons and Zartler

682 Quantitative Management Analytical Techniques *I and II, 3*
Development and application of the principal mathematical and statistical techniques used in model building and decision-making under certainty and uncertainty. *(Lec. 3) Prerequisite: MGS 581 or permission of instructor.* Jarrett, Budnick, Mojena

683 Business Decision Theory *I, 3*
A statistical analysis of managerial decision-making under uncertainty. Bayesian statistical inference and subjective probability are stressed. Comparisons between Bayesian method and classical statistics are discussed and applications to business problems are emphasized. *(Lec. 3) Prerequisite: MGS 580, 581 or equivalent.* Jarrett, Sanghvi

684 Advanced Programming Methods in Management Decisions *II, 3*
Introduction to integer, nonlinear and dynamic programming. Emphasis on application of modern mathematical optimization techniques in single-stage and multiple-stage management decision problems. *(Lec. 3) Prerequisite: MGS 580 and 682 or equivalent.* Jarrett, Sanghvi

MARINE AFFAIRS (MAF)

521 Coastal Zone Law *II, 3*
Examination of the authority of different levels and agencies of government to make decisions affecting coastal regions. Survey of existing and proposed state and national legislation affecting coastal regions. *(Lec. 3)* Cameron

651, 652 Marine Affairs Seminar *I and II, 3 each*
Interdisciplinary seminar conducted by Marine Affairs Program faculty supplemented by guest speakers from industry and government. Focuses on problems of marine resources development and management at the local/state, national and international policy levels. *(Lec. 3) Prerequisite: permission of director.* Alexander, Gamble and Cameron

MARKETING MANAGEMENT (MMG)

443 Retail Store Management *I, 3*

452 International Marketing *II, 3*

462 Marketing Research *II, 3*

464 Marketing Policy and Problems *II, 3*

466 Quantitative Marketing Management *II, 3*

474 Advertising Seminar *I, 3*

475 Advertising Campaigns *II, 3*

481, 482 Directed Study *I and II, 3 each*

550 Marketing Theory and Practice *I and II, 2*
Analytical approach to contemporary theory and practice of marketing management. *(Lec. 2)* Staff

651 Marketing Management *I, 3*
Analysis of marketing problems and determination of marketing policies in product development, promotion, pricing, channel selection; legal aspects. *(Lec. 3) Prerequisite: MMG 550 or equivalent.* Louden, Nason

656 International Marketing Management *I and II, 3*
Marketing policy-making for the multinational firm; organizing for international marketing; its opportunities, pricing, channels, promotion, research. *(Lec. 3) Prerequisite: MMG 550 and 651.* Staff

658, 659 Seminar in Marketing *I and II, 3 each*
Preparation and presentation of papers on selected topics in marketing. *(Lec. 3) Prerequisite: MMG 550, 651, or permission of instructor.* Staff

MATHEMATICS (MTH)

418 Matrix Analysis *II, 3*

423 Introduction to Differential Geometry *I, 3*

425 Topology *I, 3*

441 Introduction to Partial Differation Equations *I, 3*

442 Vector and Tensor Analysis *II, 3*

444 Ordinary Differential Equations *II, 3*

451 Introduction to Probability and Statistics *I, 3*

452 Mathematical Statistics *II, 3*

456 Probability *II, 3*

461 Methods of Applied Mathematics *I, 3*

462 Functions of a Complex Variable *II, 3*

471 Introduction to Numerical Analysis I *I and II, 3*

472 Introduction to Numerical Analysis II *I, 3*

492 Special Problems *I and II, 1-3*

513 Linear Algebra *I or II, 3*
Linear spaces and transformations, linear functionals, adjoints, projections, diagonalization, Jordan form of matrices, inner products; positive, normal, self adjoint and unitary operators; spectral theorem, bilinear and quadratic forms. *(Lec. 3)* Papadakis

515, 516 Algebra I, II *I and II, 3 each*
Groups, rings, modules, commutative algebra. *(Lec. 3) Prerequisite: MTH 316.* Fraleigh

525 Topology I *II, 3*
Topological spaces, separation properties, connectedness, compactness, uniformities. Function spaces, spaces of continuous functions and complete spaces. *(Lec. 3) Prerequisite: MTH 425 or equivalent.* Grove

526 Topology II *II, 3*
Homotopy, fiberspaces, homology and cohomology. Notions of homological algebra. Products. *(Lec. 3) Prerequisite: MTH 525.* Staff

535, 536 Measure Theory and Integration *I and II, 3 each*
Elements of topology and linear analysis. Lebesgue measure and integration in R, in R^n, and in abstract spaces. Convergence theorems. Bounded variation, absolute continuity, and differentiation. Lebesgue-Stieltjes integral. Fubini and Tonelli theorems. The classical Banach spaces. *(Lec. 3) Prerequisite: MTH 336.* Barron

545, 546 Ordinary Differential Equations I, II *I and II, 3 each*
Existence and uniqueness theorems. Continuous dependence on parameters and initial conditions. Singularities of the first and second kinds, self-adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems. Elements of asymptotic theory. Elements of stability theory of Lyapunov's second method. *(Lec. 3) Prerequisite: MTH 335 and 462.* Roxin

550 Advanced Probability *I, 3*
Investigation in depth of a topic in foundations or applications of modern probability theory. *(Lec. 3) Prerequisite: MTH 451.* Pakula

551 Advanced Mathematical Statistics I *I, 3*
Thorough development of classical and modern statistics: sampling theory, asymptotic sampling, theory for large samples, exact sampling distributions. Theory of estimation including unbiased estimates, consistent estimates, sufficient statistics, non-parametric and parametric statistics and multidimensional confidence regions. Theory illustrated by applications from various fields. *(Lec. 3) Prerequisite: MTH 452, 335, or permission of instructor. MTH 335 may be taken concurrently.* Pakula

552 Advanced Mathematical Statistics II *II, 3*
Continuation of MTH 551: tests of significance, sample hypothesis, composite hypothesis, most powerful tests, unbiased tests, analysis of variance, regression and multiple regression. Utility of the theory illustrated by applications from various fields. *(Lec. 3) Prerequisite: MTH 551.* Staff

561 Advanced Applied Mathematics *II, 3*
Linear spaces, theory of operators, Green's functions, eigenvalue problems of ordinary differential equations. Application to partial differential equations. *(Lec. 3) Prerequisite: MTH 461.* Finizio

562 Complex Function Theory *I, 3*
Analytic continuation, Riemann surfaces. The theory of conformal mapping. Representation theorems and applications. Entire functions. *(Lec. 3) Prerequisite: MTH 462.* Grove

572 Numerical Analysis *II, 3*
Further numerical methods of solution of simultaneous equations, partial differential equations, integral equations. Error analysis. *(Lec. 3) Prerequisite: MTH 472.* Lewis

591, 592 Special Problems *I and II, 1-3 each*
Advanced work, under the supervision of a member of the department and arranged to suit the individual requirements of the student. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601 Seminar *I and II, 3*
A graduate seminar in the field of specialization of a member of the department. *Prerequisite: permission of department.* Staff

629, 630 Functional Analysis I, II *I and II, 3 each*
Banach and Hilbert spaces, basic theory. Bounded linear operators, spectral theory. Applications to analysis. Application to a special topic such as differential operators, semigroups and abstract differential equations, theory of distributions, or ergodic theory. *(Lec. 3) Prerequisite: MTH 536 and permission of instructor.* Driver

641 Partial Differential Equations I *I, 3*
First order systems. The Cauchy-Kowalewsky theorem. The Cauchy problem. Classification of partial differential equations. Hyperbolic equations. Mainly the theory of the subject. Students interested in techniques for the solution of standard equations should take MTH 441. *(Lec. 3) Prerequisite: MTH 215, 335, and 462.* Staff

642 Partial Differential Equations II *II, 3*
Elements of potential theory. Elliptic equations. Green's function. Parabolic equations. Introduction to the theory of distributions. *(Lec. 3) Prerequisite: MTH 641.* Staff

645, 646 Selected Topics in Differential Equations I, II *I and II, 3 each*
Advanced topics of current research in differential equations will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

659, 660 Selected Topics in Applied Mathematics I, II *I, II, 3 each*
Advanced topics of current research in applied mathematics will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

691, 692 Special Topics I, II *I and II, 3 each*
Advanced topics of current research in mathematics will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

901 Mathematics Colloquium *I and II, 0*
Current topics in various fields of mathematics, given by special lecturers. *Prerequisite: permission of department.* Staff

MECHANICAL ENGINEERING AND APPLIED MECHANICS (MCE)

417 (or ELE 417) Direct Energy Conversion *II, 3*

423 Design of Machine Elements *I, 3*

424 Dynamics of Machines *I, 3*

425 Lubrication and Bearings *I, 3*

426 Advanced Mechanics of Materials *II, 3*

427 (or ZOO 427) Modeling and Analysis of Dynamic Systems *I, 3*

428 Mechanical Control Systems *II, 3*

429 Comprehensive Design *II, 3*

437 Rocket Propulsion *II, 3*

438 Internal Combustion Engines *I, 3*

439 Applied Energy Conversion *II, 3*

448 Heat and Mass Transfer *I, 3*

455 Advanced Fluid Mechanics *I, 3*

457 (or OCE 457) Fluidics *II, 3*

463 Intermediate Dynamics *I, 3*

464 Vibrations *II, 3*

491, 492 Special Problems *I and II, 1-6 each*

501, 502 Graduate Seminar *I and II, 1 each*
Discussions, presentation of papers based on research or detailed literature surveys. Attendance is required of all students in graduate residence. *(Lec. 1)* Staff

503 Linear Control Systems
See Electrical Engineering 503.

515 (or CHE 515) Combustion *II, 3*
Combustion phenomena including chemical reactions and kinetics, ignition and quenching, flame propagation, detonation waves, propellant combustion; applications to heat engines, propulsion devices, control of unwanted fires, and pollution due to combustion. *(Lec. 3) Prerequisite: MCE 342 and 354 or CHE 313 and 342 or 344 or equivalent.* Conta

517 (or ELE 517) Magnetofluidmechanics *I or II, 3*
Basic concepts and equations governing the interaction between electromagnetic fields and a moving, electrically conducting, continuum fluid. Wave motions in MFM systems and engineering applications. *(Lec. 3) Prerequisite: MCE 455 and ELE 511 or PHY 431, or permission of instructor.* Lessmann

521 Reliability Analysis and Prediction *II, 3*
Statistical analysis of failure of complex engineering systems, design factors contributing to functional system survival, failure, distribution functions, redundancy, confidence, reliability testing. *(Lec. 3) Prerequisite: MTH 451 or equivalent, MCE 423 or permission of instructor.* Nash

524 Advanced Kinematics and Linkage Design *I, 3*
Systematics of mechanisms and synthesis of linkage design. *(Lec. 3) Prerequisite: MCE 423.* Hatch

531 Underwater Power Systems
See Ocean Engineering 531.

532 Coastal Zone Power Plants
See Ocean Engineering 532.

540 Environmental Control in Ocean Engineering
See Ocean Engineering 540.

541 Thermodynamics *I, 3*
Advanced study of classical thermodynamics with emphasis on basic concepts, laws, and thermodynamic relations. *(Lec. 3) Prerequisite: MCE 341, 354.* Brown, DeLuise, Wilson

542 Statistical Thermodynamics *II, 3*
Irreversible thermodynamics, kinetic theory of gases, statistical thermodynamics and the development and application of the partition function. *(Lec. 3) Prerequisite: MCE 341.* Wilson

545 Heat Transfer *I, 3*
Conduction in two and three dimensions and conducting systems with radiation and fluid motion. Solutions obtained by mathematics, computer-numerical methods, and analog devices. *(Lec. 3) Prerequisite: MCE 448.* Schenck, Test

546 Convection Heat Transfer *II, 3*
Relationship between heat transfer and fluid flow with emphasis on the solution of governing equations by exact methods, integral methods and similarity techniques. *(Lec. 3) Prerequisite: MCE 448.* Test

550 Theory of Continuous Media *I, 3*
Basic course for first-year graduate students which develops and unifies the laws of mechanics as applied to the behavior of continua. Application to solids and fluids. *(Lec. 3) Prerequisite: CVE 220, MCE 354, 372, or permission of instructor.* Dowdell, Kim

551 Fluid Mechanics I *I, 3*
Basic treatment of real fluid flows using the continuum approach. Solutions of the fundamental system of equations with and without temperature variations. *(Lec. 3) Prerequisite: MCE 354 or its equivalent.* Dowdell, Hagist, White

552 Fluid Mechanics II *II, 3*
Continuation of MCE 551 including incompressible irrotational flow, laminar and turbulent shear flows and other special topics of current interest. *(Lec. 3) Prerequisite: MCE 551.* Dowdell, Hagist, White

553 Flow of Compressible Fluids *II, 3*
Fundamental equations of compressible fluid flow. Solutions of these equations for subsonic, transonic, supersonic, and hypersonic velocities. *(Lec. 3) Prerequisite: MCE 551 or permission of instructor.* Staff

563 Advanced Dynamics *I and II, 3*
Dynamics of a system of particles, Lagrange's equations from an advanced point of view. Variational methods, non-conservative and non-holonomic systems; matrix-tensor specifications of rigid body motions, normal coordinates. Hamilton's equation of motion, canonical transformation, Hamilton-Jacobi theory. *(Lec. 3) Prerequisite: MCE 463 or permission of instructor.* Velletri

564 Advanced Vibrations *I, 3*
Theory of vibration of systems with concentrated masses and stiffness; systems with one degree of freedom, vibration isolation systems with many degrees of freedom, matrix methods, dynamic vibration absorbers, torsional vibration, approximate numerical methods. Experimental methods and design procedures. *(Lec. 3) Prerequisite: MCE 464.* Bradbury, Palm, Nash

565 Advanced Vibrations *II, 3*
Theory of vibration with continuously distributed mass and stiffness. Wave, characteristic function and integral equation methods of solution of string, longitudinal and torsional systems. Vibration and critical speeds of beams and rotating shafts, the methods of Rayleigh, Ritz, and Stodola, and self-excited vibrations. *(Lec. 3) Prerequisite: MCE 564.* Bradbury, Nash

572 Theory of Elasticity *II, 3*
Advanced theory of elasticity of isotropic and anisotropic bodies; plane stress and plane strain analysis via classical and Muskhelishvili's method, three-dimentional applications in torsion, bending, and semi-infinite solids. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Kim

573 Theory of Plates *I and II, 3*
Theory of plates and application to plates of various shapes under various loadings. *(Lec. 3) Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff, Kim, Nash

575 Elastic Stability *I and II, 3*
Stability analysis of bars under separate and combined axial, lateral, and torsional loadings; buckling of plates and shells, energy methods and numerical methods. *(Lec. 3) Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

645 Boiling Heat Transfer and Two-phase Flow
See Chemical Engineering 645.

646 (or CHE 646) Radiation Heat Transfer *I or II, 3*
Radiant exchange between surfaces. Radiative properties of surfaces. Exchange among non-ideal surfaces. Gas-

radiative exchange. Radiative exchange with volume emitters. Furnace design applications. *(Lec. 3) Prerequisite: MCE 545 or CHE 644 or permission of instructor.* Brown

651 Turbulent Flows *I, 3*
Turbulent flows from both the phenomenological and statistical points of view. Applications to meteorology, boundary layers and turbulent diffusion. *(Lec. 3) Prerequisite: MCE 551 or permission of instructor.* Hagist, Lessmann, White

652 Experimental Methods in Fluid Mechanics *II, 3*
An over-view of measurement techniques and instrumentation used in the current practice of experimental fluid mechanics. Course emphasizes hot wire, hot film and laser anemometry. Provides practical laboratory experience. *(Lec. 2, Lab. 3) Prerequisite: MCE 551 or permission of instructor.* Dowdell, Hagist, Lessmann

666 Nonlinear Mechanics *I and II, 3*
Dynamics of nonlinear systems, free and forced oscillations; graphical methods, integral curves, singular points, limit cycles and stability. Van der Pol equation, perturbation methods, approximate methods, application to ecological systems. *(Lec. 3) Prerequisite: MCE 564.* Nash, White

673 Thermal Stress Analysis *I, 3*
Theory of stress and deformation in bodies subjected to thermal environments and restraints. Application to problems in thermoelasticity, thermal fatigue, thermoplasticity, and creep analysis. *(Lec. 3) Prerequisite: MCE 448, 550.* Kim, White

674 Theory of Shells *I and II, 3*
Development and application of membrane and bending theories of shells of various shapes. Variational methods and buckling of shells. *(Lec. 3) Prerequisite: CVE 220, MCE 573, or permission of instructor.* Kim

677 Fatigue Failure and Fracture Mechanics *II, 3*
Advanced study of fracture induced by repeated loading, damage theories, fundamental theories of microscopic crack initiation and growth, statistical aspects of fatigue failure, theory of crack propagation. *(Lec. 3) Prerequisite: MTH 451, MCE 429, 550, or permission of instructor.* Nash

679 Plasticity and Creep *II, 3*
Stress-induced flow of nominally solid materials, effect of temperature, combined stress problems; stress-dependent creep of metals at elevated temperatures, creep buckling, anelastic creep, related dislocation theory. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Goff

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem.) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

MEDICINAL CHEMISTRY (MCH)

443, 444 Organic Medicinal Chemistry *I and II, 3 each*

497, 498 Special Prbolems *I and II, 1-5 each*

501 Radiopharmaceuticals *I, 3*
The theoretical and applied aspects of the commonly used isotopes of pharmaceutical significance with emphasis on the diagnostic, therapeutic, and tracer applications in biological systems and techniques of development, formulation, quality control, and safe utilization. *(Lec. 2, Lab. 3) Prerequisite: CHM 228 or PHY 112, or permission of department.* Smith

526 Lipid Chemistry
See Food and Resource Chemistry 526.

533 Advanced Drug Assay *I and II, 2-4*
Advanced chemical and physical methods of analytical control related to pharmaceutical research and industrial pharmacy. *(Lec. I, Lab. 3-9) Prerequisite: MCH 342.* Smith

548 (or PCG 548) Physical Methods of Identification *II, 3*
Utilization of physical methods (primarily spectroscopic) in the structure elucidation of complex organic molecules. Emphasis on interpretation of ultraviolet, infrared, nuclear magnetic resonance, mass and optical rotatory dispersion spectra. *(Lec. 3) Prerequisite: CHM 425 and/or permission of instructor.* Abushanab, Shimizu and Turcotte

549 Synthesis *I and II, 3*
Theoretical and applied aspects in synthesis of selected organic compounds of medicinal significance. *(Lab. 9) Prerequisite: permission of department.* Abushanab and Turcotte

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621, 622 Seminar *I and II, I each*
Seminar discussions including presentation of papers on selected topics in medicinal chemistry. *(Lec. I) Students attend seminar each semester while in graduate resi-*

dence, but a maximum of 1 credit per year is allowed. No more than 3 credits allowed for the entire period of residence. Staff

643 Advanced Organic Medicinal Chemistry *II, 3*
Synthesis, modes of action, and effects on pharmacological activity. Analgesics, cholinergics, folic acid antagonists, diuretics, and sulfonamides are included. *(Lec. 3) Prerequisite: CHM 421 and permission of instructor. In alternate years, next offered 1975-76.* Staff

646 Alkaloids *I, 3*
Advanced course dealing with proof of structure, synthesis, chemical properties and biological activity of various alkaloids. *(Lec. 3) Prerequisite: permission of department.* Abushanab

697, 698 Research in Medicinal Chemistry *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics in medicinal chemistry. *(Lab. 3-9) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

MICROBIOLOGY (MIC)

401 Advanced Bacteriology *I, 4*

408 (or ZOO 408) Introduction to Protozoology *II, 4*

412 Food Microbiology *II, 3*

422 (or PLP 422) Industrial Microbiology *II, 3*

432 Pathogenic Bacteriology *II, 3*

491, 492 Research in Microbiology *I and II, 1-6 each*

495, 496 Seminar in Microbiology *I and II, 1 each*

533 Immunity and Serology *I, 3*
Various immune reactions, nature of antigens and antibodies, and formation and action of latter. *(Lec. 2, Lab. 3) Prerequisite: MIC 201 and 1 semester organic chemistry and senior standing.* Carpenter

541 Physiology of Bacteria *I, 4*
Bacterial structure and function, including growth, nutrition, environmental factors, metabolism, biosynthesis, and energy-yielding reactions. *(Lec. 3, Lab. 3) Prerequisite: MIC 201, 2 semesters of organic chemistry and 1 semester of biochemistry.* Wood

552 Microbial Genetics *II, 3*
Recent research on the mechanisms of mutation and genetic recombination, the process of DNA replication, the genetic code, and regulation of DNA, RNA, and protein synthesis in microorganisms. *(Lec. 2, Lab. 3) Prerequisite: MIC 201, BOT 352, and BCH 311.* Cohen

567 Marine Bacteriology
See Oceanography 567.

593, 594 The Literature of Bacteriology *I and II, 2 each*
Thorough study of original literature of some phase of bacteriology. Written abstracts or papers on assigned topics are discussed in weekly conferences with instructor. *(Lec. 1-2)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621 Systematic Bacteriology *I, 4*
Conferences, assigned readings, and laboratory work designed to give a knowledge of principles of classification of bacteria as well as methods of identifying and describing unknown species. *(Lec. 3, Lab. 3) Prerequisite: MIC 432 and either MIC 412 or 533. In alternate years, next offered 1975-76.* Houston

691, 692 Research in Microbiology *I and II, 3 each*
Assigned research on an advanced level. Student required to outline problem, conduct the necessary literature survey and experimental work, and present his observations and conclusions in a report. *(Lab. 6) Prerequisite: graduate standing.* Staff

695, 696 Graduate Research Seminar *I and II, 1 each*
Reports of research in progress or completed. *(Lec. 1) Required of all graduate students in microbiology.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for Virology, see Animal Pathology and Plant Pathology; for Mycology, see Botany.

MUSIC (MUS)

407 The Symphony *II, 3*

408 The Opera *II, 3*

418 Composition *II, 3*

419 Composition *I, 2*

420 Counterpoint *II, 3*

422 Advanced Orchestration *II, 2*

427, 428 Sixteenth-Century Counterpoint *I and II, 2 each*

431 The Baroque Era *I, 3*

432 The Classical Era *II, 3*

433 The Romantic Era *I, 3*

441 Special Projects *I and II, 3*

445 Music in the Elementary School *I, 3*

446 Teaching General Music *II, 3*

451 Applied Music as Minor or Elective *I and II, 2*

461 Applied Music Major *I and II, 4*

481, 482 Piano Literature and Pedagogy *I and II, 2 each*

539 Advanced Principles of Music Education I *I, 3*
Analysis of philosophical, psychological, and historical foundations of music education. Development and significance of objectives and principles of music education in the United States. *(Lec. 3) Prerequisite: graduate standing in music.* Motycka

540 Advanced Principles of Music Education II *II, 3*
Critical study of principles of objectives, program, method, administration, supervision, and evaluation of music education in the United States. *(Lec. 3) Prerequisite: MUS 539.* Motycka

545 Musical Aptitude and Achievement *I, 3*
Intensive analysis of musical aptitude and achievement, from a thorough examination of existing devices to the consequent realization of research data via basic statistical concepts. *(Lec. 3) Prerequisite: graduate standing in music, EDC 371 or PSY 434 or equivalent.* Motycka

548 Research in Music Education *II, 3*
Examination of research techniques as applied to the art of music. Extant major project procedures and data in the research categories: historical, analytical, experimental, descriptive, and philosophical. *(Lec. 3) Prerequisite: MUS 545.* Motycka

551 Applied Music as Minor or Elective *I and II, 2*
Private instruction. One 40-minute lesson and scheduled practice hours each week. One level, one year, as prescribed in applied minor syllabi. Afternoon recital required each semester. *(Studio 6) Prerequisite: completion of applied minor in undergraduate upper division and permission of department.* Staff

Select area of instruction from the following and add to course number as MUS 551B, Piano:

A Voice	H Bass Viol	Q French Horn
B Piano	J Flute	R Trombone
C Organ	K Oboe	S Baritone Horn
D Harpsichord	L Clarinet	T Tuba
E Violin	M Bassoon	U Percussion
F Viola	N Saxophone	V Guitar
G Violoncello	P Trumpet	

NUCLEAR ENGINEERING (NUE)

538 (or CHE 538) Nuclear Metallurgy *II, 3*
Metallic materials of particular interest in nuclear engineering. Production and physical metallurgy of uranium, thorium, the transuranium elements, and the rare earths; protection against corrosion, radiation damage. *(Lec. 3) Prerequisite: CHE 332.*

581 (or CHE 581) Introduction to Nuclear Engineering *I and II, 3*
Survey course of the field emphasizing the special application of principles learned in the several specialized branches of engineering. Major topics are nuclear physics, problems in design of reactor cores, materials of construction, instrumentation and control, and health physics. *(Lec. 3) Prerequisite: PHY 340 or 341.* Knickle

582 (or CHE 582) Radiological Health Physics *I, 3*
Fundamentals of health physics and radiation protection are covered. Calibration and use of survey and monitoring equipment are emphasized in the laboratory. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor. In alternate years.* Rose

583 (or CHE 583) Nuclear Reactor Theory *II, 3*
Elementary theory of self-sustained nuclear reactors. Diffusion and slowing-down theory of neutrons and the determination of the critical size and homogeneous thermal reactors with and without reflectors. One-group, two-group and modified two-group approaches. *(Lec. 3) Prerequisite: PHY 340 or 341.* Knickle

585 (or CHE 585) Measurements in Nuclear Engineering *I, 3*
Basic techniques used in measuring the interaction of radiation and matter. Principles of ionization chambers, proportional and Geiger-Mueller counters, scintillation counters, related circuitry. Laboratory stresses thorough familiarization with these instruments. *(Lec. 2, Lab. 3) Prerequisite: PHY 340 or 341 or permission of department.* Rose

586 (or CHE 586) Nuclear Reactor Laboratory *II, 3*
Theoretical and experimental determination of reactor characteristics. Experimental equipment includes a neutron howitzer, a subcritical training reactor and a one megawatt swimming pool reactor. Digital and analog

computer facilities are utilized in calculation. *(Lec. 1, Lab. 4) Prerequisite: NUE 585.* Rose

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

682 (or CHE 682) Radiation Shielding *II, 3*
Detailed study of the problems involved in radiation shielding. The principles of radiation protection are briefly reviewed first. *(Lec. 3) Prerequisite: NUE 581. In alternate years.* Knickle

683 (or CHE 683) Advanced Nuclear Reactor Theory *II, 3*
Advanced treatment of nuclear reactor theory, emphasizing the transport theory and multi-group calculations. Determination of critical size of heterogeneous reactors. Time-dependent transient behavior and basic theory of reactor control. Use of digital and analog computers. *(Lec. 3) Prerequisite: NUE 583.* Rose

687 (or CHE 687) Nuclear Chemical Engineering *II, 3*
Applications of chemical engineering to the processing of materials for and from nuclear reactors. *(Lec. 3) Prerequisite: NUE 581 and permission of instructor. In alternate years.* Rose

NURSING (NUR)

501, 503 Advanced Clinical Nursing *I or II, 3 each*
Cross-clinical seminar through which the graduate student is helped to broaden and deepen knowledge of theory, concepts and problems that are common to all nursing. *(Lec. 3) Must be taken concurrently with NUR 502, 504.* Staff

502, 504 Advanced Clinical Nursing Practicum *I or II, 3 each*
Intensive study of significant nursing problems in health agencies, selected cooperatively by student and instructor with regard to student's needs and interests. A substantial paper involving independent study in NUR 501, 502, 503, 504 is required. *(Lec. 1, Lab. 6) Must be taken concurrently with NUR 501, 503. Required of all graduate students in nursing.* Staff

505 Research in Nursing *I, 3*
Current research in nursing, emphasizing interpretation and applications. Methodology related to clinical nursing and community health. Students select a problem and develop a project as a learning experience. *Prerequisite: graduate standing and a basic course in statistics.* Staff

506 Independent Study in Nursing *I and II, 3*
Intensive study of a specific area of interest, a problem or issue in nursing under guidance of the faculty. *Prerequisite: permission of graduate faculty.* Staff

510 Teaching in Clinical Nursing *I or II, 3*
A seminar in which the student is assisted in planning, developing, implementing and evaluating classroom and clinical teaching. *(Lec. 3) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 511.* Staff

511 Teaching Practicum *I or II, 3*
Supervised teaching experience in student's major field of interest. *(Lec. 1, Lab. 6) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 510.* Staff

512 Administration in Nursing Service *I or II, 3*
A seminar in which the student is assisted in the development of the philosophy and processes in administration as they relate to nursing service and nursing education. *(Lec. 3) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 513.* Staff

513 Practicum in Administration of Nursing Service *I or II, 3*
Directed experience in nursing service in the student's major field of interest. *(Lec. 1, Lab. 6) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 512.* Staff

OCEAN ENGINEERING (OCE)

457 Fluidics *II, 3*

500 Basic Ocean Engineering *I and II, 3*
Introduction for non-engineering students to the classic engineering disciplines as they relate to marine affairs. Course is descriptive and deals with current engineering practice. *(Lec. 3) Prerequisite: senior standing. No program credit for graduate engineering students.* Sheets

512 Hydrodynamics of Floating and Submerged Bodies I *I, 3*
Hydrodynamic principles associated with floating and submerged bodies: resistance, propulsion, static and dynamic stability. *(Lec. 3) Prerequisite: MCE 455 or equivalent.* Kowalski

513 Hydrodynamics of Floating and Submerged Bodies II *II, 3*
Continuation of OCE 512. Problems of maneuvering, control, and motions in waves. *(Lec. 3) Prerequisite: MCE 455 or equivalent.* Kowalski

521 Materials Technology in Ocean Engineering *I, 3*
Requirements for ocean engineering materials. Material characteristics, fracture toughness, notch sensitivity, energy absorption, speed of loading and fatigue in salt water. Steel, aluminum, titanium, plastics, concrete, and applicable regulations. *(Lec. 3) Prerequisite: permission of instructor.* Sheets

524 Marine Structural Design
See Civil Engineering 524.

531 (or MCE 531) Underwater Power Systems *II, 3*
Low output power systems. Overall considerations appropriate to the determination of power requirements for underwater systems. *(Lec. 3) Prerequisite: MCE 342, 448 or permission of instructor.* Brown and Rose

532 (or MCE 532) Coastal Zone Power Plants *I, 3*
Overall systems consideration for coastal zone power plants. Consideration of factors such as political and legal problems, thermal pollution, and multi-use of plants (acquaculture, etc.). *(Lec. 3) Prerequisite: MCE 342, 448 or permission of instructor.* Brown and Rose

534 Corrosion and Corrosion Control
See Chemical Engineering 534.

535 Advanced Course in Corrosion
See Chemical Engineering 535.

540 (or MCE 540) Environmental Control in Ocean Engineering *II, 3*
Application of the principles of thermodynamics, heat transfer, and fluid dynamics to the requirements of human survival and engineering operations in deep and shallow water. *(Lec. 3) Prerequisite: permission of instructor.* Schenck

560 (or ELE 560) Introduction to Data Collection Systems *I, 3*
Practical problems of data collection. Probes and sensors, interfaces, signal conditioning, and storage. Examples found among the current research areas within ocean engineering will be emphasized. *(Lec. 3) Prerequisite: graduate standing in engineering or permission of instructor.* Haas

565 Ocean Laboratory I *I or II, 3*
Measurements, experiments, operation of apparatus in the ocean and in the laboratory. Statistical theory, planning multivariable experiments, checking of data, etc., *(Lec. 1, Lab. 6) Prerequisite: graduate standing in engineering or oceanography, or permission of instructor.* Schenck and LeBlanc

566 Ocean Laboratory II *I or II, 3*
Planning long-term experiments in the ocean. Carrying out a synoptic ocean program using vessels, buoys, underwater sensors and locations of opportunity. Student manages experiment, and writes technical report. *(Lab. 6-8) Prerequisite: OCE 565.* Schenck and LeBlanc

571 (or ELE 571) Underwater Acoustics I *I, 3*
Wave equation, energy, pressure and particle velocity. Acoustic properties of the sea. Elementary sources, refraction, reflection, ray theory, normal modes and scattering, with emphasis on sound propagation in the ocean. *(Lec. 3)* Moffett

581 Coastal Engineering Geology
See Geology 581.

587 Submarine Soil Mechanics *I, 3*
Soil mechanics principles as applied to submarine slope stability, heaving, sinkage and anchorage problems with emphasis on effective stress principle and selection of shear strength of marine sediments. *(Lec. 3) Prerequisite: CVE 380 or equivalent.* Nacci

591, 592 Special Problems *I and II, 1-6 each*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirement of the student. *(Lec. or Lab. according to nature of problem) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

605, 606 Ocean Engineering Seminar *I and II, 1 each*
Seminar discussions including presentation of papers based on research or literature survey. *(Lec. 1) Attendance is required of all students in graduate residence. A maximum of 1 credit per year is allowed, no more than 2 credits for the entire period.* Staff

610 Engineering Ocean Mechanics *II, 3*
Applied concepts of ocean flow processes; waves due to gravity, wind, and layered media; large and small scale turbulence; prediction of flow instability; wave forces on structures. *(Lec. 3) Prerequisite: CHE 344, MCE 354 or equivalent.* White

651, 652 Advanced Design *I and II, 3 each*
Advanced course coordinating engineering principles and economics in the design of a complete ocean engineering device. Problems investigated individually with the guidance of one or more instructors. *Prerequisite: CHE 351, 352 or IDE 404 or equivalent.* Staff

653, 654 Ocean Engineering System Studies *I and II, 3 each*
Systems engineering study of an advanced ocean engineering problem. Students will operate as a complete engineering team with specific subsystems designs done with individual faculty members. *(Lec. 3)* Sheets

661 Analysis of Oceanographic Data Systems *I, 3*
Design of systems for deep ocean and estuarine data collection and processing. Space-time sampling, multivariate analysis and convergence of moments as applied to ocean data estimation and system design. Current topics in ocean data systems. *(Lec. 3) Prerequisite: ELE 506 or equivalent.* LeBlanc

672 (or ELE 672) Underwater Acoustics II *II, 3*
Transducers, radiators and receivers, directivity (array structures) equivalent circuits, efficiency; piezoelectricity, magnetostriction, sonar principles, measurements and calibration. *(Lec. 3)* Moffett and DiNapoli

673 Advanced Course in Underwater Acoustic Propagation *I, 3*
Analysis of propagation from a concentrated acoustic source in the ocean by methods such as advanced normal mode theory, numerical integration and fast Fourier transforms. Applications to ocean features such as surface ducts, shadow zones, deep sound channel, etc. *(Lec. 3) Prerequisite: OCE 571 or equivalent.* DiNapoli

674 Nonlinear Acoustics *II, 3*
Topics in the nonlinear acoustics of fluids. Propagation and interactions of finite-amplitude sound waves. Parametric sonar. Sound generation by turbulence. Cavitation noise. Shock waves. Underwater explosions. Radiation pressure and acoustic streaming. *(Lec. 3) Prerequisite: OCE 571 or permission of instructor.* Moffett

675 Processing of Underwater Acoustic Data *II, 3*
Description of the underwater acoustic environment. Methods of measuring underwater acoustic signals. Data analysis of passive and active signals. Applications of underwater acoustics to oceanographic survey. *(Lec. 3) Prerequisite: ELE 506 or equivalent.* LeBlanc

691, 692 Special Problems *I and II, 1-6 each*
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

OCEANOGRAPHY (OCG)

401 General Oceanography *I, 3*

501 Physical Oceanography *I, 3*
Basic course covering physical properties of seawater, heat budget, distribution of variables, dynamics, water masses and general circulation, waves and tides. *(Lec. 3) Prerequisite: PHY 213, MTH 141.* Knauss

509 Ecological Aspects of Marine Pollution *II, 2*
Biological, chemical, and physical aspects of selected agricultural, industrial, and domestic effluents in the marine and estuarine environment. Case histories emphasizing toxicological effects. Concept of bioassay as an analytical tool is developed. *(Lec. 2) Prerequisite: OCG 401 or permission of instructor.* Eisler

510 Descriptive Physical Oceanography *II, 3*
Observed distributions of temperature, salinity, currents; methods of deducing deep flow; physical properties of seawater; flow in estuaries; practical work in the analysis of oceanographic data; study of recent literature. *(Lec. 3) Prerequisite: OCG 501. In alternate years, next offered 1975-76.* Richardson

521 Chemical Oceanography *II, 3*
Processes regulating the composition of seawater, and the distribution of chemical species. The interaction of marine chemistry with the ocean floor, atmosphere and marine organisms. *(Lec. 2, Lab. 2) Prerequisite: CHM 103, 104 and 112, PHY 213.* Pilson

524 Chemistry of the Marine Atmosphere *II, 3*
Chemistry and physics of marine aerosols, trace gases, and precipitation; cycles and budgets of atmospheric nitrogen, sulfur, halogen, and carbon compounds; effects of man on the marine atmosphere. *(Lec. 3) Prerequisite: OCE 521 and CHM 332 or permission of instructor. In alternate years, next offered 1974-75.* Duce

540 Geological Oceanography *II, 3*
Origin of ocean basins; geomorphology, sediments, volcanism, structure and tectonics of the deep-sea floor; character and development of continental margins, beaches and estuaries. *(Lec. 2, Lab. 2) Prerequisite: GEL 103 or ESC 105 or permission of instructor.* McMaster

545 Geomagnetism and Paleomagnetism *I, 3*
Description of past and present magnetic fields of the Earth. Principles, methods, results of the application of paleomagnetism to diverse geological, geophysical, and paleontological problems. Lectures and seminars. *Prerequisite: PHY 213 and/or 214 and MTH 142 and/or 243 and/or 244 and some geology, GEL 103 and/or 104, or permission of instructor.* Staff

547 Seminar in Biomagnetism *I, 2*
Effect of weak and strong magnetic fields on marine and terrestrial organisms in the present and in the past. Introductory lectures on artificial and natural magnetic fields, followed by seminars by students and guests. *(Lec. 2) Prerequisite: permission of instructor.* Watkins

561 Biological Oceanography *I, 3*
Nature of life in the sea; adaptations, patterns of distribution and production of plankton, nekton and benthos, their interrelationships and interaction with the environment. *(Lec. 2, Lab. 2) Prerequisite: ZOO 111.* Pratt

567 Marine Bacteriology *I, 3*
Present concepts of the distribution, nature, and functions of bacteria and related microorganisms in the marine environment. Methodology includes sampling, culture, taxonomy and study of their physical and physiological ecology. *(Lab. 6) Prerequisite: CHM 104 and MIC 201, or permission of instructor. In alternate years, next offered 1974-75.* Sieburth

568 Fishery Biology *II, 3*
Biology of fish populations and methods of fishery research, including influence of environmental factors on

morphology, physiology, abundance and distribution of fishes, estimation of stocks, growth, aging, mortality, measurement of fish production and theory of fishery regulation. *(Lec. 3) Prerequisite: permission of instructor.* Saila

571 Benthic Environment *I, 3*
Lectures, readings, seminar presentations, discussion and project work on the physical-chemical properties and total ecology of the benthic marine environment. Includes tidal marshes, rocky intertidal areas, estuarine shoals, coral reefs and deep-sea benthos. *(Lec. 2, Lab. 2) Prerequisite: permission of instructor.* Nixon

574 Biology of Marine Mammals *II, 2*
Migration, reproduction, social organization, classification, anatomy, populations, physiology and communications of cetaceans and pinnipeds. *(Lec. 1, Lab. 3) Prerequisite: permission of instructor. In alternate years, next offered 1974-75.* Winn

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

605 Dynamical Oceanography *I, 3*
Simple steady state theories applied to ocean motion. Review of well-known force balances in oceanography, wind driven circulation, thermohaline circulation, the thermocline, oceanic boundary layers, near shore circulation, diffusion. *(Lec. 3) Prerequisite: OCG 501.* Kenyon

607 Geophysical Models *I, 4*
Selected laboratory experiments modeling the motions of oceans and atmospheres. Comparison of effects of rotation and stratification. Thermal and thermohaline convection, inertial waves and boundary layer phenomena. Emphasis on experimental research techniques and preparation of technical reports. *(Lec. 3, Lab. 3) In alternate years, next offered fall 1974.* Lambert

609 Dynamics of Mixing *I, 3*
Theories of the thermocline and the problem of vertical mixing. Relation of mean vertical mixing coefficients to detailed mechanisms of mixing. Internal waves, shear instabilities, lateral spreading and entrainment, thermohaline convection, small scale turbulence. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered fall 1975.* Lambert

610, 611 (611) Geophysical Fluid Dynamics *I and II, 3 each*
Physics of ocean circulation: surface wave generation, rotating fluids, density currents, quasi-geostrophic motion, laminar viscous flow, turbulence, wind driven ocean circulation, stratification, convection, thermohaline convection, horizontal convection and thermoclines. *(Lec. 3) Prerequisite: a prior course in fluid dynamics, and permission of instructor.* Stern

613 Waves *I, 3*
Generation, propagation and decay of surface waves, internal waves, and Rossby waves in the ocean. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Kenyon

614 Tides *II, 1*
Generation, propagation, and dissipation of ocean tides. Relation between theory and observation. *(Lec. 1) Prerequisite: OCG 501.* Kenyon

621 (or REN 621) The Estuary and Coastal Zone *I, 3*
Multi-disciplinary course on characteristics of estuaries and adjacent coastal waters and ecological, economic, engineering and other considerations applicable to development, management, and conservation of such waters. *(Lec. 2, Rec./Proj. 1) Prerequisite: advanced (second year) graduate standing and approval of course chairman.* Marshall and Lampe

623 Physical Chemistry of Seawater *I, 3*
Characterization of dissociation, solubility and redox equilibria in seawater. Partial molar volumes, conductivity and diffusion of ions in seawater. Kinetic studies in seawater; effects of temperature, salinity and pressure on physicochemical properties in seawater. *(Lec. 3) Prerequisite: OCG 521 and CHM 332 or permission of instructor.* Kester

625 Organic Geochemistry *I, 3*
Chemistry of organic matter in seawater and recent marine sediments. Topics include source, characterization, significance and fate of dissolved, particulate and sedimentary organic compounds. *(Lec. 3) Prerequisite: CHM 222 or permission of instructor.* Quinn

630 Geochemistry *II, 3*
Introduction to the study of distribution of the elements in the natural environment. Emphasis on an understanding of the chemical principles and chemical processes which govern this distribution. *(Lec. 3) Prerequisite: CHM 104 or 112 and GEL 103 or permission of instructor.* Schilling

631 Seminar in Marine Chemistry *I and II, 1*
Discussion of problems of current interest in marine chemistry. *(Lec. 1) Prerequisite: OCG 521 or permission of instructor.* Staff

641, 642 (645) Geology of Continental Margins I and II *I and II, 3 each*
641: geomorphology, sedimentology, and structure of continental shelves, borderlands, slopes and rises with consideration of origin and developmental sequence of continental margins. *642:* characteristics of continental margins compared with those of island arcs, small ocean basins and geosynclines. Origin and evolutionary relationships considered within the framework of global tectonics. *(Lec. 3) Prerequisite: OCG 540, 641 (for 642), GEL 470 and 550. In alternate years, next offered 1975-76.* McMaster

643 Seminar in Deep-Sea Geology *I, 3*
Class discussion of selected topics in deep-sea geology based on extensive reading in the scientific literature. A research paper by each student and lectures will supplement the discussions. *(Lec. 3) Prerequisite: permission of instructor.* Krause

644 Thermodynamics of the Earth's Interior *II, 3*
Review and application of thermodynamics to geological problems. Crystal-melt equilibria, phase transitions, hydration reactions; coprecipitation laws and fractionation processes; effect of the geothermal and pressure gradients, convection. *(Lec. 3) Prerequisite: GEL 103 and a course in thermodynamics such as CHM 433, or PHY 420, or CHE 313 and 314, or MCE 341 or permission of instructor.* Schilling

646 Deep-Sea Sediments and Process *II, 3*
Deep-sea sediments and their relation to oceanic processes such as solution, productivity and dilution. Sedimentary distributions in time and space as related to tectonic models. Paleoclimatology, and past water mass distributions and conditions. Term paper. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered spring 1976.* Kennett

647, 648 (647) Recent Sedimentary Environments I and II *I and II, 3 each*
Concentrated study of sedimentary environments with primary emphasis on the relationships between sediment properties of each environment and its environmental conditions. *647:* beach, lagoon, estuary and bay. *648:* continental shelf, slope and rise. *(Lec. 3) Prerequisite: OCG 501, 540, GEL 550. In alternate years, next offered 1974-75.* McMaster

649 Marine Paleoecology *I, 3*
Concepts of paleoecology. Review of Pleistocene and Tertiary paleo-oceanography, paleoclimatology and paleoecology. Criteria and methods used in marine paleoecology especially those related to foraminifera radiolaria. Biogeography and paleoecology of Cenozoic planktonic faunas. *(Lec. 2, Lab. 1) In alternate years, next offered fall 1974.* Kennett

651 Cenozoic Marine Stratigraphy *I, 2*
Extensive reading and class discussion of concepts and methods of biostratigraphy, chronostratigraphy and lithostratigraphy as applied to the Cenozoic. Stratigraphic nomenclature. Problems and advances in correlation and dating of marine sediments from distinct oceanographic regimes including type European sections. *(Lec. 2) In alternate years, next offered fall 1975.* Kennett

660 (662) Ecological Concepts in Marine Research *I, 3*
Advanced course in ecology, emphasis on marine environment. Ecological theory pertaining to stability and diversity of natural communities and perturbed systems. Field work in Narragansett Bay on zooplankton, benthos, nekton. *(Lec. 1, Lab. 4)* Jeffries

661 (or BOT 661) Phytoplankton Taxonomy *I, 3*
Classical and modern systems and techniques for the identification, nomenclature, and classification of planktonic algae, with emphasis on marine forms. Phylogeny will be briefly considered. *(Lec. 1, Lab. 4) Prerequisite: permission of instructor. In alternate years, next offered fall 1974.* Hargraves

663 (or BOT 663) Phytoplankton Physiology *I, 3*
Metabolic processes and methods of their investigation in phytoplankton with primary emphasis on functions pertinent to their ecology. Includes adaptation, uptake of nutrients, excretion, rhythms, pigments, and photosynthesis. *(Lec. 3) Prerequisite: permission of instructor.* Swift

664 (or BOT 664) Phytoplankton Ecology *II, 4*
Biology, ecology, methods of investigation and introductory systematics of the pelagic marine microscopic plants; stress on their adaptations, physiological ecology, distribution, succession, production, and regional and seasonal dynamics. *(Lec. 3, Lab. 3) Prerequisite: permission of instructor.* Smayda

666 Zooplankton *I, 3*
Biology of marine zooplankton, dealing with morphology, adaptation, distribution, physiology, production and interrelationships with other members of the marine biota. *(Lec. 1, Lab. 4) Prerequisite: permission of instructor.* Napora

667, 668, 669 (or BOT 667, 668, 669) Advanced Phytoplankton Seminars *II, 2 each*
Specialized and advanced areas of phytoplankton biology and research, including systematics, physiology and ecology. *(Sem. 3) Prerequisite: permission of instructor.* Hargraves, Smayda and Swift

672 Marine Invertebrates and Environment *II, 3*
Physiological responses of marine invertebrates to seasonal and geographical changes in the environment. Survival, metabolism, reproduction and larval development of the populations. Mechanisms in adaptation during stages in life cycle examined in relation to changes of certain environmental factors. Physiological variation of populations related to speciation process. Lectures, reading and discussion. Research project. *(Lec. 3) Prerequisite: OCG 561 and permission of instructor.* Sastry

679 (or ZOO 679) Animal Communication *I, 2*
Visual, chemical and auditory communication in animals, including receptor systems, feedback and redundancy. Functional aspects and organization of communication. Discussion of readings. Research problem can be taken under OCG 691 or ZOO 693. *(Lec. 2) Prerequisite: ZOO 467 or equivalent and permission of instructor. In alternate years, next offered 1974-75.* Winn

681 (or ZOO 681) Biological Clocks and Orientation *I, 2*
Circadian, lunar-tidal, annual, and other activity

rhythms. Orientation particularly related to migratory and daily movements. Covers sun, moon and star compass, odor trails, magnetic factors, echolocation, and other factors. Research problem can be taken under OCG 691 or ZOO 693. *(Lec. 2) Prerequisite: ZOO 467 or equivalent and permission of instructor. In alternate years, next offered 1975-76.* Winn

691, 692 Individual Study *I and II, 1-6 each*
Individual study of assigned topics or special problems, involving literature search and/or original investigation under one or more members of the staff. *(Lec., Lab. TBA)* Staff

693, 694 Special Studies *I and II, 1-4 each*
Studies of specialized topics in the marine sciences. *(Lec., Lab. TBA)* Staff

695 Seminar in Oceanography *I and II, 1*
Students to give seminar reports on problems and current research in various areas of oceanography. Attendance is required of all students in graduate residence but no more than 4 hours are allowed for a program of study. *(Lec. 1)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: graduate students in oceanography choose from supporting courses in other departments.

ORGANIZATIONAL MANAGEMENT AND INDUSTRIAL RELATIONS (OMR)

407 Administrative Practices *I, 3*

410 (GBA 410) Business Policy *II, 3*

422 Labor Relations Law and Legislation *II, 3*

423 Industrial Relations *II, 3*

431 Advanced Management Seminar *I, 3*

480 Small Business Management *I and II, 3*

491, 492 Special Problems *I and II, 3 each*

504 Business Policy *II, 3*
Determination of objectives and planning programs of action, creating an organization and launching a program; controlling execution of plans; reappraising objectives. Studies of administrative situations. *(Lec. 3) Prerequisite: permission of department.* Staff

530 Management Theory and Practice *I and II, 2*
Management applied to business, objectives, policies, organization staffing and control; production personnel, behavioral science applications; the role of quantitative methods. *(Lec. 2)* Staff

626 Organizational Behavior *I and II, 3*
Incorporates the insights gleaned from the disciplines of psychology, sociology, anthropology and the social sciences of politics, economics and history in the study of the behavior of organizations and of their principal actors. *(Lec. 3) Prerequisite: OMR 530 or equivalent.* Coates, deLodzia, Desfosses and Allen

627 Advanced Organization Theory and Behavior *I and II, 3*
Previous knowledge of classical and traditional management thought used to provide concepts, analytical approaches, and skills for understanding how behavioral sciences influence complex organizational systems. *(Lec. 3) Prerequisite: OMR 626.* Coates, deLodzia, Desfosses and Allen

631 Human Resources Management *I and II, 3*
Role of human resources management, its functional relationship within an organization with emphasis on behavioral concepts and their application. Text, cases and research. *(Lec. 3) Prerequisite: OMR 530.* Staff

638, 639 Seminar in Industrial Management *I and II, 3 each*
Class discussion of typical cases, original research work in the field of industry with discussion of data collected and analyzed by individual students. *(Lec. 3) Prerequisite: permission of department.* Staff

681 (GBA 681) Administrative Policy and Decision-making *I and II, 3*
Review of the functional areas of marketing, production, finance, economics, accounting, quantitative methods, organizational theory, interpersonal relationships, control and motivation systems, and communications. Includes the M.B.A. written comprehensive examination according to Graduate School requirements. *(Lec. 3) Prerequisite: all M.B.A. foundation courses or undergraduate equivalents and a minimum of 21 M.B.A. credits at the 600 level which must include MMG 651, FIN 641, ACC 611.* Staff

PHARMACOGNOSY (PCG)

445, 446 General Pharmacognosy *I and II, 3 each*

447 General Pharmacognosy Laboratory *I and II, 1*

459 Public Health *I and II, 3*

497, 498 Special Problems *I and II, 1-3 each*

521, 522 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on

selected topics in pharmacognosy. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. No more than 3 credits for entire period.* Staff

533 Medicinal Plants *I, 2*
Problems in drug plant chemotaxonomy with field work in the drug plant gardens. Emphasis is placed on certain alkaloid, glycoside and oil-yielding plants. Weedicides and insecticides as related to measures for control. *(Lec. 1, Lab. 3) Prerequisite: PCG 446 or permission of department.* Staff

536 Antibiotics *II, 3*
Advanced course on concept of antibiosis, biosynthesis pathways of antibiotic production, testing, chemistry, mechanism of action, medicinal and pharmaceutical uses of antibiotics. Phenomena of sensitivity and resistance; emphasis on entities of importance in pharmaceutical research and production. *(Lec. 3) Prerequisite: permission of department. In alternate years.* Worthen

548 Physical Methods of Identification
See Medicinal Chemistry 548.

551, 552 Chemistry of Natural Products *I and II, 3 each*
Introduction to chemistry of certain groups of natural products especially in relation to their chemotaxonomic position in plant classification. Topics limited to secondary metabolites: e.g. terpenoids, phenolic compounds, aromatic compounds, phytosterols, alkaloids. *(Lec. 3) Prerequisite: CHM 228 and 230. In alternate years, next offered 1975-76.* Shimizu and Lyon

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee

633, 634 Biosynthesis *I and II, 3 each*
Biogenesis of medicinally active principles of biological origin. Emphasis given to organic acids, polysaccharides, glycosides, steroids and certain nitrogenous compounds. *(Lec. 3) In alternate years, next offered 1974-75.* Staff

635, 636 Pharmacognosy Techniques *I and II, 3-4 each*
Physical and chemical factors influencing growth and development of active principles of drug plants. Certain biological analyses of results are performed. *(Lec. 1, Lab. 6-9)* Staff

697, 698 Research in Pharmacognosy *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACOLOGY AND TOXICOLOGY (PCL)

441, 442 General Pharmacology *I and II, 4 each*

443, 444 General Pharmacology Laboratory *I and II, 1 each*

453 Clinical Pharmacology and Toxicology *I, 3*

497, 498 Special Problems *I and II, 1-3 each*

521, 522 Seminar *I and II, 1 each*
Seminar discussions and presentation of papers on selected topics in pharmacology. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed, no more than 3 credits for entire period.* Staff

542 Evaluation of Drug Effects *II, 5*
Theory, methods and techniques involved in the determination of qualitative and quantitative activity and relative toxicity of drugs. *(Lec. 2, Lab. 9) Prerequisite: PCL 441 and 442, MGS 501, or equivalent and permission of department. In alternate years.* DeFanti and DeFeo

544 Forensic Toxicology *II, 3*
Theoretical and practical aspects of poisoning including the isolation and identification of toxic materials from pharmaceuticals, body fluids and tissues. Isolation and identification of physiological fluids from stains, hairs, and tissue with application to forensic medicine. *(Lec. 2, Lab. 3) Prerequisite: PCL 441, 442 and permission of department. In alternate years, next offered 1975-76.* DeFanti

546 Advanced Toxicology *II, 4*
Toxic effects of selected drugs and other zenobiotics on physiological and biochemical processes. *(Lec. 3, Lab. 4) Prerequisite: PCL 441, 442 or equivalent, and permission of department. In alternate years, next offered 1975-76.* Carlson

550 Operant Analysis of Behavior
See Psychology 550.

562 Psychopharmacology *II, 3*
Effects of drugs on animal and human behavior and on related biochemical processes. *(Lec. 3) Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years.* Lal

564 Psychopharmacology Laboratory *II, 1-3*
Laboratory exercises to demonstrate effects of drugs on animal and human behavior. To earn more than one credit, the student will engage in original work of limited scope. *(Lab. 3-9) Prerequisite: PCL 441 or equivalent and/or permission of department.* Lal

572 Neural Bases of Drug Action *II, 3*
Review of neuroanatomy, neurochemistry, and neuro-

physiology as they are related to drug action. *(Lec. 3) Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years.* Lal

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

641 Biochemical Pharmacology *I, 4*
Theory and application of pharmacological studies at the cellular and subcellular levels and their significance to drug action in the intact organism. *(Lec. 3, Lab. 3) Prerequisite: PCL 441 and 442 and permission of department. In alternate years.* Fuller

643 Advanced Pharmacology and Techniques *I, 4*
Mechanism of action of drugs on living tissues, organs and organisms with particular emphasis on cellular physiology as a basis of explanation of tissue response. Advanced laboratory techniques as employed for pharmacological testing. *(Lec. 2, Lab. TBA) Prerequisite: PCL 442, and permission of department. In alternate years.* DeFeo

697, 698 Research in Pharmacology *I and II, 1-5 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY (PHC)

425 History of Pharmacy *I and II, 3*

451 Clinical Pharmacy *I, 3*

497, 498 Special Problems *I and II, 1-3 each*

499 Clinical Practicum *II, 3-12*

501 Drug Information Pertaining to Institutional Pharmacy Practice *I, 3*
Discussion and evaluation of drug information sources, and how to use these sources. Includes the methodology of establishing and maintaining drug information services. *(Lec. 2, Pract. 3)* Jeffrey and Staff

521, 522 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on selected topics in pharmacy. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed, not more than 3 credits for entire period.* Staff

552 Advanced Clinical Pharmacy *II, 3*
In-depth study of clinical pharmaceutical methods and the applications of these methods in the clinical environment on rounds and in conferences. *(Lec. 1, Lab. 6) Prerequisite: PHC 451 or equivalent, and/or permission of department.* Cooper and Fish

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611, 612 Residency in Hospital Pharmacy *I and II, 6 each*
Residency consists of 2,000 hours of training and practice, under supervision, in the hospital pharmacy as prescribed and accredited by the American Society of Hospital Pharmacists: Rhode Island Hospital (accredited), Roger Williams Hospital (accreditation pending). Jeffrey and Fish

621, 622 Manufacturing Pharmacy *I and II, 2-5 each*
Theory of and practice in the manufacture of pharmaceuticals and the principles of operation of the equipment used for their production. *(Lec. 2, Lab. 0-9)* Paruta

625, 626 Hospital Pharmacy Administration *I and II, 2 each*
Hospital organizations, including intra- and inter-department relationships, the medical and service staff problems, the administrator, personnel management, pharmaceutical service with relation to patient care, medical and pharmaceutical research, *(Lec. 3)* Jeffrey, Gallina and Pincus

631 Advanced Physical Pharmacy *I, 3-5*
Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents are determined. *(Lec. 3, Lab.3-6) Prerequisite: CHM 332 or permission of department.* Paruta

632 Advanced Physical Pharmacy *II, 2-4*
Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents determined. *(Lec. 2, Lab. 0-6) Prerequisite: PHC 631.* Paruta

641 Pharmaceutical Formulations *I, 2-4*
Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. *(Lec. 2, Lab. 3-6) Prerequisite: PHC 632.* Paruta

642 Pharmaceutical Formulations *II, 2-5*
Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. *(Lec. 2, Lab. 3-9) Prerequisite: PHC 632.* Paruta

662 Biopharmaceutics *I, 3*
Pharmacokinetic principles as applied to absorption, metabolism, and excretion of drugs from finished dosage forms. Includes oral, parenteral, topical and sustained release forms. *(Lec. 3) Prerequisite: PHC 384. In alternate years, next offered 1975-65.* Ballard

697, 698 Research in Pharmacy *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY ADMINISTRATION (PAD)

405 Pharmacy Personnel Administration *I, 2*

406 Pharmacy Retailing *II, 4*

451 Pharmacy Administration Principles *II, 3*

453 Drug Marketing Principles *II, 2*

497, 498 Special Problems *I and II, 1-3 each*

570 Case Studies in Pharmacy Law *II, 3*
Case studies and a detailed analysis of the FDC, Controlled Substances Act, health insurance laws. *(Lec. 3) Prerequisite: PAD 351.* Campbell and Jacoff

580 Prepaid Drug Plans *I, 3*
Institutional relationships involved in the prescribing, dispensing and prepayment of drugs. Problems of interference with pharmaceutical or medical practice arising from different types of prepayment plans. Actual experience, laws and court decisions, abuse and controls. *(Lec. 3) Prerequisite: PAD 451 and 453 or equivalent.* Campbell and Jacoff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee. Staff

621, 622 Seminar *I and II, 1 each*
Seminar discussions and presentation of papers on selected topics in pharmacy administration. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed, no more than 3 credits for entire program.* Staff

651, 652 Health Care Systems I and II *I and II, 3 each*
Arrangements for utilizing pharmaceutical resources in public and private systems of health care in the U.S. and other countries. Variations in quality and distribution of care among socio-economic groups. *(Lec. 3) Prerequisite: PAD 580 and EST 408 or 409, or equivalent.* Jacoff

697, 698 Research in Pharmacy Administration *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy administration. *(Lab. TBA)* Staff

PHILOSOPHY (PHL)

401, 402 Special Problems *I or II, 3 each*

405 Aesthetics *I or II, 3*

440 Philosophy of Language *I or II, 3*

441 Metaphysics *I or II, 3*

442 Epistemology *I or II, 3*

502, 503, 504, 505 Tutorial in Philosophy *I and II, 3 each*
Discussion by the staff and advanced students of research problems in philosophy. Presentation and criticism of original papers. *(Lec. 3)* Staff

512 Seminar in Ethics and Value Theory *I or II, 3*
Intensive studies of various issues, theories and aspects in the field of values and valuation. The texts of leading moralists will be carefully analyzed. *(Lec. 3) In alternate years.* Staff

530 Philosophy of Plato *I or II, 3*
Selected dialogues from the later period. Particular attention will be given to the areas of metaphysics, epistemology, cosmology, and ethics. *(Lec. 3) In alternate years.* Staff

531 Philosophy of Aristotle *I or II, 3*
Selected texts with emphasis on the major concepts of Aristotle's metaphysics, theory of knowledge, and ethics. *(Lec. 3) In alternate years.* Staff

540 Philosophy of Augustine *I or II, 3*
Examination of the philosophical background of Augustine's thought and of his doctrines of knowledge and reality with reference to his influence on the subsequent philosophical development in medieval and modern thought. *(Lec. 3) In alternate years.* Staff

541 Philosophy of Aquinas *I or II, 3*
Critical examination of the major contribution of Aquinas to metaphysics, epistemology, and philosophical psychology. *(Lec. 3) In alternate years.* Staff

551 Philosophical Logic *I or II, 3*
Intensive consideration of such issues as the nature, structure and function of propositions, predication, analysis of the "is" relation. Relation between propositions and facts. Nature of logic and criterion of the logical, relation of logic to language, psychology and ontology. *(Lec. 3) In alternate years.* Staff

552 Philosophy of Science *I or II, 3*
Inquiry into the nature and history of scientific thought, with emphasis on analysis of fundamental concepts of the physical and biological sciences in the order of human knowledge, their importance for human existence. *(Lec. 3) Prerequisite: PHL 101 and a year of either physical or biological science or permission of instructor.* Staff

560 British Empiricists *I or II, 3*
Intensive analysis of the work of one or more of the British empiricists: Locke, Berkeley, or Hume. *(Lec. 3) In alternate years.* Staff

561 Continental Rationalists *I or II, 3*
Intensive analysis of the work of one or more of the continental rationalists: Descartes, Spinoza or Leibnitz. *(Lec. 3) In alternate years.* Staff

570 Philosophy of Immanuel Kant *I or II, 3*
Intensive analysis of major texts. Special attention will be given to *The Critique of Pure Reason. (Lec. 3) In alternate years.* Staff

580 Nineteenth-Century Philosophy *I or II, 3*
Intensive analysis of the work of a major philosopher or philosophical movement. Attention will be given to such major figures as Hegel, Kierkegaard, C. S. Peirce, or James. The specific subject changes from year to year. *(Lec. 3) In alternate years.* Staff

581 Twentieth-Century Anglo-American Philosophy *I or II, 3*
Intensive analysis of the work of one contemporary British or American philosopher or philosophical movement. The specific subject changes from year to year. *(Lec. 3) In alternate years.* Staff

590 Contemporary European Philosophy *I or II, 3*
Intensive analysis of the works of selected representatives of such schools as neo-Kantianism, phenomenology, neo-positivism, neo-Hegelianism, historicism, and vitalism. *(Lec. 3) In alternate years.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHYSICAL EDUCATION (PED)

410 Adaptive and Corrective Physical Education *I, 3*
Physical Education for Men (PEM) 410.

410 Corrective and Adapted Physical Education *I, 3*
Physical Education for Women (PEW) 410.

495 Directed Study *I and II, 3*
Physical Education for Women (PEW) 495.

510 Current Problems in Physical Education, Health and Recreation *I or II, 3*
Current problems in physical education, health, and recreation designed to acquaint the students with conditions that give rise to problems and various techniques used in finding solutions to them. *(Lec. 3) Prerequisite: permission of department.* Staff

520 Curriculum Construction in Physical Education *I or II, 3*
Analysis of criteria and procedures for curriculum construction in physical education. Standards for the evaluation and revision of elementary and secondary school physical education courses. *(Lec. 3) Prerequisite: permission of department.* Polidoro

530 Research Methods and Design in Health and Physical Education *I or II, 3*
Introduction to methodology in experimental, laboratory, curriculum, action, and historical research. *(Lec. 3) Prerequisite: competence in basic statistics and permission of department.* Sonstroem

540 Principles of Recreation Leadership *I or II, 3*
Modern concepts of responsibilities involved in program planning in schools and community agencies. Leadership of committees and board relations as well as practical program promotional techniques. *(Lec. 3) Prerequisite: permission of department.* Leathers

543 Outdoor Recreation and Education *I or II, 3*
Investigation of the present scope and significance of the present-day outdoor recreation and education movements and an examination of current ideas and practices. *(Lec. 3) Prerequisite: permission of department.* Leathers

550 Administration of Physical Education *I or II, 3*
Problems and procedures for administering a physical education program studied from the viewpoint of the physical education administrator, the school administrator and the faculty. Emphasis is placed upon the study of administrative cases. *(Lec. 3) Prerequisite: PEM 380. Staff*

560 Seminar in Health, Physical Education and Recreation *I or II, 3*
Selected topics within the three areas, depending on availability of specialized instruction including visiting professorships. *(Lec. 3) Prerequisite: permission of department.* Staff

570 Major Health Problems and Curriculum Planning in Health Education *I or II, 3*
Major health problems related to personal and community health with emphasis on health education, curricu-

lum planning and evaluation. *(Lec. 3) Prerequisite: permission of department.* DelSanto

575 Perceptual-motor Education *I or II, 3*
Role of motor activity in enhancing perceptual development. How the physical educator can become involved, with other school personnel in the implementation and continuing development of perceptual-motor programs. For teachers in elementary schools and in special education who wish to incorporate motor activities into their programs. *(Lec. 3) Prerequisite: PSY 113, 232 and permission of instructor.* Staff

580 Physical Education for the Mentally Retarded *I, 3*
Introduction to the contributions of physical education to the growth and development of mentally retarded. Basic movement, rhythms, games, sports, stunts, tumbling, gymnastics, apparatus, etc. for both educable and trainable mentally retarded. *(Lec. 3) Prerequisite: permission of instructor.* McCormick

581 Psychological Aspects of Physical Activity *II, 3*
Scientific principles and research from psychology related to physical activity. Educational program situations amenable to research and application of psychological principles are isolated. Recommendedations for improvements in physical education methodology. *(Lec. 3) Prerequisite: PSY 113, 232 and permission of instructor.* Sonstroem

585 Physical Education for the Atypical Child *I, 3*
Limitations, needs, learning characteristics of the physically and mentally handicapped child which apply to verbal response, body control, kinethesis and neuromuscular acceptance. Research reviewed and synthesized for a practical problem. *(Lec. 3) Prerequisite: ZOO 121, 242, and kinesiology recommended.* Slader

591 Special Problems *I or II, 3*
Written paper reporting an in-depth investigation of a pertinent problem in the field, including a review of relevant literature, analysis and solution of the problem based on scientific methodology, with recommendations for improved practices. Limited to and required of all master's degree candidates in physical education who elect the non-thesis option. Staff.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHYSICS (PHY)

401, 402 Seminar in Physics *I and II, 1 each*

406 Introduction to Atmospheric Physics *I, 3*

420 Introduction to Thermodynamics and Statistical Mechanics *I, 3*

421 Introduction to Theoretical Physics *I, 3*

425 Acoustics *I, 3*

431 Introduction to Theoretical Physics *II, 3*

451 Atomic and Nuclear Physics *I, 3*

452 Nuclear Physics *II, 3*

455 Introduction to Solid State Physics *II, 3*

483, 484 Laboratory and Research Problems in Physics *I and II, 3 each*

491, 492 Special Problems *I and II, 1-6 each*

510, 511 Mathematical Methods of Physics *I and II, 3 each*
Definition of a vector, vector algebra and calculus, scalar and vector fields, linear vector operators, coordinate transformations, vector operations in curvilinear coordinates, dyadics, tensors, simple applications of the theory of finite groups. Partial differential equations of physics and their solutions; diffusion equation, wave equation, Schrodinger equation, Klein-Gordon equation, elements of the theory of probability. *(Lec. 3) Prerequisite: permission of department.* Staff

520 Classical Dynamical Theory I *I, 3*
Lagrange's equations, holonomic and non-holonomic constraints, applications to dynamical systems, non-inertial systems, alternate formulations of mechanics, theory of small vibrations, variational principles, Hamiltonian formulation of dynamics, canonical transformations. *(Lec. 3) Prerequisite: PHY 421, 510.* Staff

521 Classical Dynamical Theory II *II, 3*
Poisson's brackets, infinitesimal contact transformations, Hamilton, Jacobi equation, action-angle variables, transition to quantum mechanics, special problems in dynamics. *(Lec. 3) Prerequisite: PHY 520.* Staff

522 Topics in the Physics of the Earth *II, 3*
Physics of the earth. Topics chosen from: elasticity, seismology, and the structure of the earth; terrestrial electricity, gravity, heat flow, magnetism, radioactivity, and tides; physics of the upper atmosphere. *(Lec. 3) Prerequisite: permission of department. In alternate years, next offered 1975-76.* Dietz

530 Electromagnetic Theory I *I, 3*
Coulomb's law, Gauss' law, scalar potential, boundary value problems, multipole expansion, dielectrics, magnetic field due to stationary currents, scalar and vector potential, magnetic materials, Faraday's law, Lorentz force, conservation laws, Maxwell's equations. *(Lec. 3) Prerequisite: PHY 431, 510.* Staff

531 Electromagnetic Theory II *I, 3*
Scalar and vector wave equations and their solutions, retarded and advanced potentials. Lienard-Wiechert poten-

tials, radiation from an arbitrarily moving charge, multipole radiation, wave guides, cavity resonators, plasma oscillations, theory of relativity. *(Lec. 3) Prerequisite: PHY 511, 530.* Staff

550 Physical Acoustics *I, 3*
Physical properties of gases, liquids and solids as revealed by the propagation of acoustic waves. Ultrasonic generation and measurement techniques, irreversible thermodynamics, mechanisms for absorption and dispersion of acoustic waves. *(Lec. 3) Prerequisite: permission of department.* Letcher

570 Quantum Mechanics I *I, 3*
Wave packets, Schrodinger equation, one-dimensional problems, hydrogen atom, harmonic oscillator, WKB approximation, operator formalism and matrix mechanics, angular momentum, perturbation theory, scattering and partial wave analysis, semiclassical treatment of the radiation field. *(Lec. 3) Prerequisite: permission of department.* Staff

571 Quantum Mechanics II *II, 3*
Dirac equation, spin orbit energy, theory of positrons, Feynman diagrams, Compton scattering, pair production and bremsstrahlung. Second quantization and application to selected topics. *(Lec. 3) Prerequisite: PHY 570.* Staff

580 Graduate Laboratory *I and II, 3*
Laboratory experiments, designed to be performed by beginning graduate students, consist of a limited number of classic experiments to be completed with precision and thoroughness. Experiments selected primarily from the areas of atomic, nuclear and solid state physics. *(Lab. 6) Prerequisite: permission of department.* Quirk

585 Acoustic Measurements *II, 1-2*
Techniques for the measurement and analysis of sound in fluids and solids. *(Lab. 3-6) Prerequisite: permission of department.* Staff

590, 591 Special Problems *I and II, 1-6 each*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem) Credits not to exceed 12. Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

620 Statistical Mechanics *I and II, 3*
Kinetic theory of matter, Maxwell-Boltzmann distribution, collision and mean free path, the H-theorem, Ergodic theorem, entropy, Nernst heat theorem, fluctuations and distributions, quantum statistics, ensemble theory, applications in nuclear physics, fluidity, condensation, electron theory of metals and relativistic gas. *(Lec. 3) Prerequisite: PHY 511, 570.* Staff

630 Electromagnetic Theory III *I, 3*
After developing the covariant formulation of electrodynamics, selected topics of current interest in electromagnetic theory such as accelerator design, etc., will be discussed. *(Lec. 3) Prerequisite: PHY 531.* Staff

650, 651 Solid State Physics *I and II, 3 each*
Quantum theory of electrons, phonons and other elementary excitations, Hartree-Fock approximation, many body problem, super conductivity, band theory and Fermi surface. *(Lec. 3) Prerequisite: PHY 455, 570.* Staff

660, 661 Nuclear Physics *I and II, 3 each*
General properties of the nucleus. Two body problem at low, intermediate and high energy. Three and four body problems, nuclear forces, special models, nuclear spectroscopy and reactions, decay of nuclei, many body problem, structure of nucleons. *(Lec. 3) Prerequisite: PHY 511, 571.* Staff

670, 671 Advanced Quantum Theory *I and II, 3 each*
Relativistic quantum field theory, free and interacting fields, the S-matrix and the perturbation expansion, quantum electrodynamics, dispersion relations, symmetry operations and invariance properties. *(Lec. 3) Prerequisite: PHY 571.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PLANT AND SOIL SCIENCE (PLS)

401, 402 Plant and Soil Science Seminar *I and II, 1 each*

405 Propagation of Plant Materials *II, 3*

411 (or FRC 411) Soil Chemistry and Fertilizers *I, 3*

412 (or FRC 412) Soil Biochemistry *II, 3*

420 Crop Ecology *I, 3*

432 Commercial Floriculture *II, 3*

442 Professional Turfgrass Management *II, 3*

444 Environmental Aspects of Landscape Design *II, 3*

450 Soil Conservation and Land Use *I, 3*

454 Identification of Basic Ornamental Plants *II, 3*

461 Weed Science *II, 3*

468 Soil Genesis and Classification *I, 4*

472 Plant Improvement *II, 3*

475 Plant Nutrition and Soil Fertility *II, 3*

491, 492 Special Projects and Independent Study *I and II, 1-3 each*

500 Growth and Development of Economic Plants *II, 3*
Factors affecting vegetative and reproductive growth and development of plants. Topics include growth regulators, auxins, environmental factors, dormancy, juvenility, vernalization and flowering. Term paper required. *(Lec. 3) Prerequisite: BOT 442. In alternate years, next offered 1974-75.* Shutak

501 to 504 Graduate Seninar in Plant and Soil Science *I and II, 1 each*
Presentation of technical reports and discussion of current research papers in soil science, landscape ecology, growth and development of economic crops and production and management of economic crops. *(Lec. 1) Prerequisite: permission of instructor.*

573 Post-Harvest Physiology of Economic Crops *I, 3*
Factors affecting post-harvest physiology of fruits, vegetables, flowers, ornamentals and sod. Influence of preharvest factors on post-harvest condition. Principles of preservation and storage. Individual or group projects. *(Lec. 3) Prerequisite: BOT 442 or equivalent. In alternate years, next offered 1974-75.* Shutak and Staff

576 Physiology of Plant Productivity *I, 3*
Critical analysis of contemporary views on energy conversion and transformation in primary plant production. Topics include photosynethesis, phosphorylation, photorespiration, transport mechanisms, carbobydrate and lipid metabolism, nitrogen assimilation and symbiosis. *(Lec. 3) Prerequisite: organic chemistry, plant physiology, biochemistry or with permission of instructor. In alternate years, next offered 1975-76.* Hull

591, 592 Non-Thesis Research in Plant and Soil Science *I and II, 1-3 each*
Advanced work under supervision of research staff to expand research experience into areas other than those related to thesis research. Arranged to suit individual requirements. *(Lab. 3-9) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PLANT PATHOLOGY-ENTOMOLOGY (PLP)

422 (or MIC 422) Industrial Microbiology *II, 3*

422 Diseases of Turfgrasses, Trees and Ornamental Shrubs *II, 3*

482 Nematology *II, 3*

561 Plant Virology *I, 3*
Nature and properties of plant viruses, survey of plant diseases caused by viruses and experience in basic techniques. *(Lec. 3) Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1975-76.* Mueller

591, 592 Research Problems *I and II, 1-3 each*
Individual or group study supervised by a faculty member in fields of plant virology, nematology and disease mechanisms, economic entomology or plant pathology, agricultural and industrial mycology and related subjects. Written reports. *(Lec. 1-3, Lab. 2-6)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611 The Nature of Plant Disease *I, 3*
Analysis of the nature of plant disease, the concepts of infection and pathogenesis, and the interaction of plant, pathogen, and environment in the disease process. *(Lec. 3) Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1974-75.* Beckman and Mueller

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for other related courses see BOT 332, 432, 434 and ZOO 481, 482, 581, 586.

POLITICAL SCIENCE (PSC)

403 Government and Society of India and Pakistan *I, 3*

407 The Soviet Union: Politics and Society *II, 3*

408 African Government and Politics *I, 3*

411 The United States and China *II, 3*

420 Radical Change in the Modern Era *II, 3*

421 State and Local Government *I, 3*

431 International Relations *I, 3*

432 International Government *II, 3*

434 American Foreign Policy *II, 3*

443 Twentieth-Century Political Theory *I, 3*

455, 456 Directed Study or Research *I and II, 3 each*

460 Urban Politics *I and II, 3*

461 The American Presidency *I, 3*

464 International Law *II, 3*

466 Urban Problems *II, 3*

470 Problems and Principles in the American Political Process *II, 3*

471 Constitutional Law *I, 3*

472 Civil Liberties *II, 3*

481, 482 Political Science Seminar *I and II, 3 each*

483 Political Process: Policy Formulation and Execution *I or II, 3*

486 Intentional Communities *II, 3*

491 Principles of Public Administration *I, 3*

495 Comparative Urban Politics *I, 3*

498 Public Administration and Policy Formulation *II, 3*

501 Administrative Theory *I and II, 3*
Theoretical constructs and models in fields of public administration; theories of Weber, Riggs, Dorsey, Simon, Presthus. Lower-level models in subfileds of organization, communications and decision-making. Task-oriented subject matter such as personnel, budget and program administration related to theoretical formulations which seek to explain them. *(Lec. 3) Prerequisite: PSC 491 or permission of department.* Grossbard

502 Techniques of Public Management *I and II, 3*
Principles and techniques employed in the administration of staff activities of the public service such as administrative planning, project scheduling and budgeting. *(Lec. 3) Prerequisite: PSC 491 or permission of department.* Staff

503 Problems in Public Personnel Administration *I or II, 3*
Development of personnel administration, including problems of recruitment, examination, promotion and staffing within public service. Emphasis on evaluation of employee performance and collective bargaining in public service. *(Lec. 3) Prerequisite: graduate standing or permission of department.* Grossbard

504 Politics of Developing Areas: Asia *II, 3*
Analysis of developments in newly independent, "third world" nations, particularly of Asia. Emerging political structures in relation to the processes of social, economic, and psychological change. *(Lec. 3) In alternate years, next offered 1975-76* Stein

507 The U.S.S.R. and China in World Affairs *I, 3*
Comparative study of the foreign policies of the Communist nations. Examines continuity and change of Soviet policy in historic perspective, competitive coexistence with the West in the post-Stalin era, China's outlook on the world, the Sino-Soviet dispute, policy toward developing areas, international organization and arms control. *(Lec. 3) Prerequisite: PSC 407 or permission of instructor.* Stein

510 Developing Nation State: Africa *II, 3*
Analysis of developmental policy formation with emphasis upon the governmental processes in the new nations with major focus on African countries. *(Lec. 3) Prerequisite: permission of instructor.* Milburn

512 Seminar in Marine Science Policy and Public Law *II, 3*
Multi-disciplinary teams of faculty and selected graduate students tackle unresolved problems in creating rules or institutions to cope with new uses of the marine environment, e.g., freedom of the seas, fisheries regulation, deep-sea mining, or weather modification. Team meetings at team convenience; plenary sessions; backup studies for team meetings plus final report. *Prerequisite: permission of department.* Staff

523 Seminar in Comparative Public Administration *I, 3*
Theory, practice, organization and operation of English and French administrative systems and their influence on newly established systems. Use of models, structure-function analysis and ecological analyses. *(Lec. 3) Prerequisite: PSC 491, 501 or permission of department.* Milburn

524 Seminar in Public Policy Problems *I and II, 3*
Exploration in depth of selected problems of policy formulation—intergovenmental relations, regionalization, citizen participation and control, priority setting for public sector programs. *(Lec. 3) Prerequisite: PSC 491, 501 or permission of department.* Grossbard

544 Democracy and Its Critics *I, 3*
Seminar examining the roots of modern democracy in the social contract theorists and analyzing the quality and limits of self-determination in these theories in the light of contemporary politics. *(Lec. 3) Prerequisite: PSC 341, 342, or permission of department.* Killilea

553 Scope and Methods of Political Science *I, 3*
Development of political science in relation to other so-

cial sciences. Political concepts, theories, and analytic systems surveyed in relation to the methodology. Latest trends and interests in the discipline. Research papers and reports explore individual problems. Required for graduate students. *(Lec. 3)* Tyler

554 Advanced Research in Political Science *II, 3*
Fundamental concepts and techniques in political science with emphasis on advanced quantitative and qualitative analysis and the application of these methods to individual research projects. *(Lec. 3) Prerequisite: PSC 553 or permission of department.* Staff

555, 556 Directed Study or Research *I and II, 3 each*
Special work arranged to meet the individual needs of graduate students in political science. *(Lec. 3) Prerequisite: permission of department.* Staff

566 American Political Thought *II, 3*
Origins and development of American political thought. Intensive study, including European influences, of the growth of ideas about democracy in America. Locke, DeTocqueville, Jefferson, Lincoln, and other representative theorists. *(Lec. 3) Prerequisite: PSC 341, 342 or permission of instructor. In alternate years.* Wood

568 Jurisprudence *II, 3*
Introduction to the philosophy of law, treating the sources, the nature, and the consequences of major systems of legal thought. Emphasis on the relationship between legal reasoning and judicial decision-making in the United States. *(Lec. 3) Prerequisite: PSC 471, 472, or permission of instructor. In alternate years, next offered 1975-76.* Wood

572 Problems in International Relations *I, 3*
Examination of such major current problems in international relations as control of atomic energy, the flowering of nationalism in Asia, the role of the United Nations, western European problems, the problem of Germany and the role of ideologies in international relations. *(Lec. 3) Prerequisite: PSC 431 or permission of department.* Staff

578 International Law and Politics of the Oceans *II, 3*
Chronological view of interaction between political processes and resulting international law of the oceans. Special emphasis on international conferences on law of the sea. Open to graduate students in Master of Marine Affairs Program and Department of Political Science, other graduate students with permission of instructor. *(Lec. 3)* Gamble

590 Internship in Public Administration *I and II, 3-6*
Participation at an administrative agency under supervision of agency head and a member of the faculty. Planning, personnel management, research organization, budgeting, interdepartmental relations, informal liaisons that are the hallmark of effective administration. *May be taken as one 6-credit unit or two 3-credit units. Prerequisite: permission of Bureau of Government Research.* Staff

595 Problems of Modernization in Developing Nations
See Resource Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PSYCHOLOGY (PSY)

410 Quantitative Methods in Psychology II *I and II, 3*

432 Advanced Development Psychology *II, 3*

434 Introduction to Psychological Testing *I and II, 3*

435 The Psychology of Social Behavior *I and II, 3*

445 Group Processes and Individual Behavior *I and II, 3*

460 The Psychology of Violence and Aggression *I and II, 3*

461 Social and Psychological Aspects of Alcoholism *I and II, 3*

463 Psychology of Personal Meaning *I or II, 3*

479 Contemporary Problems for Modern Psychology *I and II, 3-12*

482 Psychobiology *II, 3*

489, 499 Problems in Psychology *I and II, 3 each*

510 Intermediate Quantitative Methods *II, 3*
Complex statistical techniques useful in practical psychological research including multiple correlation and regression analysis, multiple correction for restriction in range, and introductory multivariate analysis methods. *(Lec. 3) Prerequisite: permission of department.* Merenda and Cain

520 Psychometric Methods *I or II, 3*
Techniques for investigating areas of attitude and opinion research, morale and leadership, personality and perception. Includes techniques of test construction, Q-methodology, and psychometric scaling. *(Lec. 3) Prerequisite: PSY 434, 510. In alternate years.* Merenda and Staff

532 Experimental Design
See Experimental Statistics 532.

534 Clinical Interpretation of Standardized Psychological Tests *II, 3*
Clinical use of standardized assessment techniques such as MMPI. Critical review of theory and research under-

lying objective, group assessment of human characteristics. Development and interpretation of individualized evaluations based on profile analysis. *(Lec. 3) Prerequisite: PSY 434.* Staff

542 The Exceptional Child *I or II, 3*
Definition and proper classification of types of exceptional children; social, psychological, and physical factors involved. Problems of rehabilitation and psychological treatment. Types of exceptional children; e.g. superior, retarded, physically handicapped, those suffering from developmental aberrations. *(Lec. 3) Prerequisite: PSY 232, 254 and permission of department.* Weiner

550 (or PCL 550) Operant Analysis of Behavior *I or II, 3*
Introduction to the principles of operant conditioning with emphasis on the use of these principles in the analysis of behavior. *(Lec. 3) Prerequisite: permission of department.* Smith

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

600 Advanced General Psychology *I or II, 3-15*
Series to provide incoming graduate students with intensive preparation in major areas of general psychology: (a) psychophysiology, (b) learning, (c) cognition and perceptual processes, (d) developmental, (e) social. *Lec. 3) May be repeated up to give times. Prerequisite: permission of department.* Staff

610 (or EST 610) Factor Analysis *II, 3*
Comparison among various procedures of factor analysis including tetrad differences, bi-factor, group centroid, principal components, canonical methods. Interpretation of factors. Estimation of factor loadings and specific variances. Methods for factor rotation. Estimation of factor scores. *(Lec. 3) Prerequisite: EST 541. In alternate years, next offered 1975-76.* Merenda and Staff

611 Methods of Psychological Research and Experimental Design *I or II, 3*
Provides the student of psychology with a knowledge of research methodology and the techniques of experimental designs. It prepares for the development of thesis problems of graduate students in psychology and related disciplines. *(Lec. 3) Prerequisite: PSY 510, 532. In alternate years, next offered 1975-76.* Merenda and Staff

616 Methodology and Design in Research in School Psychology *I or II, 3*
Models of research design and methodology particularly applicable to the school situation are explored. *(Lec. 3) Prerequisite: PSY 510, 532, permission of department.* Staff

617 Methodology and Design in Research in Clinical Psychology *I or II, 3*
Models of research design and methodology particularly pertinent to the area of clinical psychology with emphasis on mental designs appropriate to research problems, using specific experiments and original research. *(Lec. 3) Prerequisite: PSY 510, 532, permission of department.* Biller

620 Seminar: Classical Conditioning *I and II, 3*
History and nature of the conditional reflex, with emphasis placed on understanding the role of the conditional reflex and contemporary behavioral research and theory. *(Lec. 3) Prerequisite: permission of department.* Smith

621 Seminar: Human Learning and Memory *I or II, 3*
Experimental analysis of major problem topics of learning and retention studies in humans. Emphasis on systematic studies of verbal habits, dimensional analysis of the critical variables influencing these habits, and the interference theory of forgetting. *(Lec. 3) Prerequisite: permission of department.* Silverstein

640 Personality Dynamics I (Advanced Personality) *II, 3*
Readings from the original sources of the major contemporary personality theorists. Emphasis on the possible integration of these theories, and the development of syncretic theory according to individual preferences. *(Lec. 3) Prerequisite: permission of department. In alternate years.* Cain

660 Personality Dynamics II (Advanced Psychopathology) *I or II, 3*
Empirical literature with regard to etiological factors involved in the formation of pathological character trends and deviations. Evaluation of clinical theory and classification systems as related to the psycho-theapeutic process. *(Lec. 3) Prerequisite: permission of department.* Prochaska

661 Psychological Services I (Administration and Interpretation of Cognitive Tests) *I, 3*
Instruction and practice in administration and interpretation of cognitive tests; individual intelligence tests of both general and specific abilities. Rationale, research evidence, clinical application of Stanford-Binet, Wechsler, Leiter International. *(Lec. 3) Prerequisite: permission of department.* Berman

662 Psychological Services II (Administration and Interpretation of Personality Tests) *II, 3*
Instruction and practice in the administration and interpretation of instruments used in the assessment of personality. Emphasis upon projective tests such as Rorschach, TAT. Rationale, research evidence and clinical application. *(Lec. 3) Prerequisite: permission of department.* Staff

663 Seminar to Accompany Field Experience in Psychological Services *I and II, 3*
All students meet in seminar to discuss and investigate specific diagnostic, therapeutic, research problems emerging in connection with internship experience. *(Lec. 3) Prerequisite: PSY 670* Staff

664 Advanced Diagnostic Problems *I or II, 3*
Use and interpretation of cognitive, projective, and neural psychological tests. Focus on integrated data into meaningful description of total personality functioning. Use of the diagnostic interview. *(Lec. 3) Prerequisite: PSY, 661, 662 and permission of instructor. In alternate years.* Berman

665 Seminar: Behavior Disorders in Childhood *I or II, 3*
Emphasis on etiological factors, diagnostic and treatment consideration, and experimental research findings related to the psychological maladjustments in infancy and childhood; treatment procedures, resources and methods used in dealing with behavior and personality problems. Lectures, discussions, and case demonstrations. *(Lec. 3) Prerequisite: PSY 660. In alternate years, next offered 1975-76.* Berman

666 Seminar: The Professional Psychologist in the Community *I and II, 3*
Ethical and professional standards related to the practice of psychological services. Discussion and guest lectures by members of related disciplines. Special emphasis upon the role of the professional psychologist in the community: (a) clinical psychology, (b) school psychology. *(Lec. 3) Prerequisite: permission of department.* Staff

670 Field Experience in Psychological Service *I and II, 6-12*
Training placements and internships are available in a variety of institutional agencies and school settings under supervision which must be acceptable to the department. *Prerequisite: equivalent of 1 year full-time graduate work, clinical practices sequence, permission of department.* Staff

671 Clinical Practices I (Diagnostic) *I or II, 3*
Supervised practice in the assessment of problem behavior. Emphasis on the integration of data from psychological tests, case histories, and other sources in the assessment of personality. Practicum facilities available in several agencies. *(Lec. 2, Lab. 2) Prerequisite: PSY 661, 662, and permission of department. In alternate years, next offered 1975-76.* Berger

672 Individual Clinical Practicum *I or II, 3-9*
Introductory experience in dealing with clinical problems in a variety of clinical settings. Individual supervision to be arranged. *(Lec. 3) May be repeated up to three times. Prerequisite: PSY 661, 662 and permission of department.* Staff

673 Seminar: Introduction to Clinical Psychotherapy *I, 3*
Theories and techniques of psychotherapeutic procedures involving directive and nondirective and play therapies. Theoretical rationale and empirical research with special emphasis on the child area. *(Lec. 3) Prerequisite: permission of department.* Willoughby and Staff

674 Clinical Practices II (Therapy) *I or II, 3-21*
Specialized techniques of clinical interviewing, counseling, and psychotherapy. Critical discussions of the student's own supervised therapy sessions: (a) individual, (b) behavior, (c) group, (d) sensitivity, (e) family, (f) childplay, (g) specialized techniques. *(Lec. 3) May be repeated up to seven times. Prerequisite: PSY 640, 660, 673, and permission of department.* Staff

675 Experimental Psychopathology *I or II, 3*
Relates recent experimental methodology and findings to prevalent theoretical positions. Emphasis on reviewing experimental literature in specialized clinical areas. *(Lec. 3) Prerequisite: permission of department.* Prochaska

676 Neurological Correlates of Psychopathology *I and II, 3*
Functioning and physiology of central nervous system with particular attention to determining how neurological disruption and injury are manifested in behavioral disorder. Techniques used to evaluate and interpret neuropsychological functioning. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1975-76.* Berman

678 Seminar: Physiology of Learning and Memory *II, 3*
Examination of theories of learning and memory in terms of biochemical changes and neurological processes. Neuroanatomy and function of higher brain systems are reviewed and related to learning and memory processes. *(Lec. 3) Prerequisite: PSY 381 or permission of instructor. In alternate years, next offered 1975-76.* Staff

680 School Practices I (Diagnostic) *I and II, 3-9*
Testing procedures and devices in the diagnosis of organicity, personality problems and devices in the diagnosis of organicity, personality problems, special learning problems, visual, auditory, and memory problems; includes administration, interpretation, and special adaptation of tests in the school situation. *(Lec. 3) May be repeated up to three times. Prerequisite: PSY 434, 661 and permission of department.* Staff

681 Special Problems in School Psychology *I or II, 3-9*
Role of the psychologist in the school setting. Several theoretical and practical issues concerned with the value of psychological theory, administrative philosophy, and school organization are explored. *(Lec. 3) May be repeated up to three times. Prerequisite: PSY 680 and permission of department.* Vosburgh, Staff

682 Individual Practicum in School Psychology *I or II, 3-9*
Accompanies student's internship in the school setting. Techniques for adapting psychological services to function within the school system. Individual supervision to be arranged. *(Lec. 3) May be repeated up to three times. Prerequisite: permission of department.* Vosburgh

683 Psychology of the Exceptional Child *I, 3*
Social, psychological and educational factors that constitute the matrix of concerns with the exceptional individual in the school and community. Recent innovations in public and private education and habilitation. Research issues and legislation discussed evolve into student studies. *(Lec. 3) Prerequisite: permission of department.* Staff

684 Learning Disabilities *I, 3*
Introduction to developments in the field of disorders of learning in the school-age child, stressing recent conceptualizations of underlying psychological parameters essential to basic processes involved in learning. Interdisciplinary approaches to diagnosis; innovation of precriptive teaching introduced. *(Lec. 3) Prerequisite: PSY 683 and/or permission of instructor.* Gross

685 Psychology of Mental Retardation *II, 3*
Etiological factors, including biogenetic, physiological and social origins of mental retardation. The epidemiology and ecological aspects considered as they interact with social and cultural forces. Historical and current philosophy of habilitation and education of school-age children and adults. *(Lec. 3) Prerequisite: permission of instructor.* Staff

686 Psychology and Education of the Emotionally Disturbed *I, 3*
Current thinking on treatment and education of residential and day-care programs for the emotionally disturbed. Meaning of the various concepts of schizophrenia, autism and hyperkinetic impulse disorder for treatment. Application of operant techniques for shaping socially appropriate behavior. Overview of origins of current operant methods in hospitals and schools. *(Lec. 3) Prerequisite: permission of instructor.* Gross

690 Seminar: Contemporary Issues in Psychology *I and II, 3-12*
Recent developments and current issues. Rigorous exploration of experimental and theoretical literature. Study limited each semester to one of the following areas: developmental, clinical, motivation, perception, psychophysics, and scaling problem solving and thinking. *A maximum of 4 seminars may be taken. (Lec. 3) Prerequisite: permission of department.* Staff

691 Individual Practicum in Teaching Psychology *I or II, 3-6*
Seminar and supervised experience in the teaching of psychology primarily at the undergraduate level. Students will be involved in laboratory and discussion groups under supervison. *(Lec. 3) May be repeated up to two times. Prerequisite: permission of department.* Camp and Staff

692, 693 Directed Readings and Research Problems *I or II, 3-6 each*
Directed readings and advanced research work under the supervision of a member of the staff arranged to suit the individual requirements of the students. *Prerequisite: permission of department.* Staff

694 Special Problems in Clinical Psychology *I or II, 3-12*
Instruction and clinical practicum training in unique problem areas of clinical psychology. Development of specialized evaluation instruments and procedures. *(Lec. 3) May be repeated up to four times. Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

RESOURCE DEVELOPMENT EDUCATION (RDE)

444 (or EDC 444) Teaching Agribusiness and Natural Resources *I, 3*

486 Internship in Agribusiness and Natural Resources *I and II, 3*

487 The Cooperative Extension Service in Today's Society *II, 3*

488 Methods and Materials for Adult Extension Education *I, 3*

489 Utilization of Paraprofessionals in Adult and Extension Education *I, 3*

RESOURCE ECONOMICS (REN)

430 International Resource Development *II, 3*

441 Economics of Food Marketing *I, 3*

450 Resource Policy and the Environment *II, 3*

491, 492 Special Projects *I and II, 3 each*

514 Economics of Marine Resources *I, 3*
Role of economics in development of marine resources. Particular attention to problems of multiple use of re-

sources and to the conflicts between private and public goals. *(Lec. 3) Prerequisite: M.M.A. students or permission of instructor.* Rorholm

527 Macroeconomic Theory
See Economics 527.

528 Microeconomic Theory
See Economics 528.

532 Land Resource Economics
See Community Planning 621.

534 Economics of Resource Development I *II, 3*
Economic theory applied to the development of human and natural resources with topics drawn from current resource use problems. Analytical techniques treated are simulation techniques, cost-benefit analysis, input-output models, growth models. Cobb-Douglas functions, and Markov chains. *(Lec. 3) Prerequisite: REN 532 and ECN 528 or equivalent, or permission of instructor.* Gates

543 Economic Structure of the Fishing Industry *I, 3*
Analysis of U.S. and world fishing industries from standpoint of activity and efficiency. Problems related to common property resources, government policy, labor, and legal and institutional factors. *(Lec. 3) Prerequisite: ECN 427 and 428 or permission of instructor.* Holmsen

550 The Economics of Exhaustible Marine Resources *II, 3*
Theory and application of natural resource analysis specifically applied to such marine resources as petroleum, sand and gravel, manganese, and other minerals. *(Lec. 3) Prerequisite: ECN 328 or permission of instructor.* Grigalunas

576 Econometrics I *I, 3*
See Economics 576.

577 (or EST 577) Econometrics II *II, 3*
Continuation of Econometrics I. *(Lec. 3) Prerequisite: REN 576.* Lampe

595 (or ECN 595, GEG 595, PSC 595 or SOC 595) Problems of Modernization in Developing Nations *II, 3*
Selected regional problems in the environmental complex, agricultural systems, population dynamics, distribution systems, political integration, urbanization-industrialization, popular participation, integrated theories of modernization. *(Lec. 3) Prerequisite: permission of instructors.* Brand (Georgraphy), Weaver (Resource Economics), Landberg (Sociology and Anthropology), Milburn (Political Science), and Suzawa (Economics)

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

602 Research Methodology *I and II, 3*
Evaluation of alternative research methods and techniques. Development of specific research projects. *(Lec. 3)* Hueth

610 Advanced Studies *I and II, 3*
Advanced topics in resource economics. Mathematical models in resource management. May be repeated for different topics. *(Lec. 3)* Staff

621 The Estuary and Coastal Zone
See Oceanography 621.

634 Economics of Resource Development II *I, 3*
Concepts of economic efficiency applied to natural resources with emphasis on marine resources. Application of welfare and institutional economics to resource development; analysis of optimum allocation among users. *(Lec. 3) Prerequisite: REN 534.* Cummings

635 Marine Resources Policy *I, 3*
Analysis of public policy problems relating to the development and management of marine resources, including fisheries, minerals, petroleum, water and recreation. *(Lec. 3) Prerequisite: REN 534.* Norton

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

RESOURCE MECHANICS (REM)

451 Soil Conservation Technology *I, 3*

484 Structures *II, 3*

RUSSIAN (RUS)

460, 461 The Russian Novel *I and II, 3 each*

497, 498 Directed Study *I and II, 3 each*

901, 902 Reading Course in Russian for Graduate Students *I and II, 0 each*
901: Fundamentals of grammar and syntax necessary to develop reading knowledge. Assumes no prior knowledge of Russian. *902:* Exercises in translating scholarly and scientific texts. Staff

SOCIOLOGY (SOC)

408 Industrial Sociology *I, 3*

410 Complex Organizations in Modern Society *II, 3*

412 Occupations, Professions, and Social Structure *I and II, 3*

414 Demography *I or II, 3*

420 Sociology of the Environment *II, 3*

422 The Sociology of the Arts *I or II, 3*

430 Social Pathology and Social Change *I, 3*

432 Ecology of the Community *I or II, 3*

434 Urban Sociology *I, 3*

436 Sociology of Politics *II, 3*

440 Sociology of Mental Illness *I and II, 3*

442 Sociology of Education *I and II, 3*

444 Sociology of Religion *I and II, 3*

446 Sociology of Knowledge *I and II, 3*

448 Sociology of Science *I and II, 3*

492 History of Sociological Thought *I, 3*

502 Contemporary Sociological Theory *II, 3*
Critical examination of the theories and systems of contemporary sociologists. *(Lec. 3) Prerequisite: 12 credits of sociology or permission of instructor.* Gardner

505 (496) Methods of Sociological Research *I, 3*
The logic of sociological inquiry with particular emphasis on the interrelationship between theory and fact through an examination of a variety of methodological procedures. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Bassis

506 Methods of Sociological Research *II, 3*
Practical application of the issues discussed in SOC 505. Experience in the art of empirical investigation culminating in the completion of a research project. *(Lec. 3) Prerequisite: SOC 505 or permission of instructor.* Bassis

508 Individual and Social Organization *I or II, 3*
Sociology of the individual as the creator, preserver, and participant in society. Emphasis upon symbolic interaction in the growth of personal idiom, the development of social structure, and of the content of social change. *(Lec. 3) Prerequisite: permission of department.* Staff

510 Seminar in Deviance *I or II, 3*
Deviation from social expectations analyzed as a social phenomenon. Emphasis on deviation theories and research pertaining to individuals, subcultures, and social systems. Discussions, oral and written reports. *(Lec. 3) Prerequisite: permission of department.* Staff

512 Concepts of Social Structure *I or II, 3*
Examination of key spheres in social organization such as stratification, institutions, communities from a variety of perspectives including consensus and coercion models, pluralist versus elitist images of power structure, and the pros and cons of functionalism. *(Lec. 3) Prerequisite: permission of department.* Staff

514 Issues and Problems of Bureaucracy *II, 3*
Classical and modern theory, research and current problems in the sociology of bureaucratic organizations. Analysis of case studies, field research, and critiques. *(Lec. 3) Prerequisite: graduate standing and/or permission of instructor.* Rosengren

516 Seminar in Law and Society *II, 3*
Social forces in the creation and function of law in American society. Roles of law enforcers. Influences of social classes and interest groups on law as an instrument of social control and change. *(Lec. 3) Prerequisite: SOC 314 or 330 or permission of instructor.* England

520 Seminar in Sociological Topics *I or II, 3*
Advanced study of selected topics in sociology. *(Lec. 3) Prerequisite: graduate or senior standing, and permission of department.* Staff

571, 572 Directed Study or Research *I and II, 3 each*
Designed to cover areas of special research interests of graduate students not covered in other courses. *(Lec. 3) Prerequisite: permission of department.* Staff

595 Problems of Modernization in Developing Nations
See Resource Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

SPANISH (SPA)

407 Intensive Practice in Conversation *I, 3*

408 Conversation and Teaching Materials *I, 3*

409 History of the Spanish Language *II, 3*

410 Field Workshops *SS, 3-6*

411 (511) Spain during the Reconquest *I, 3*

430 Castilian Literature of the Sixteenth and Seventeenth Centuries *II, 3*

450 Neo-Classicism and Romanticism *I, 3*

451 The Spanish Novel of the Nineteenth Century *I, 3*

461 The Generation of 1898 *I, 3*

462 Contemporary Spanish Writers *II, 3*

471 Introduction to Hispanic-American Literature *I and II, 3 each*

481 Don Quijote *I, 3*

483 The Origins of the Novel in Spain *I, 3*

485 The Modern Spanish Novel *II, 3*

488 The Drama of the Golden Age *II, 3*

495 Hispanic Civilization *II, 3*

497, 498 Directed Study *I and II, 3 each*

512 Spanish Literature of the Fifteenth Century *II, 3*
Folk ballads and courtly poetry as well as prose writings reflecting the rise of new cultural currents. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1975-76.* Navascués

573 Modern Hispanic-American Poetry *I, 3*
Hispanic-American poetry from the last two decades of the nineteenth century to the present. Critical study with special attention to Martĭ, Darío, González Marínez, Gabriela Mistral, Ibarbourou, Neruda. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Navascués

574 Hispanic-American Novel *II, 3*
Hispanic-American novel with particular emphasis on its trends in the twentieth century. Thr works of such writers as Isaacs, Cambaceres, Azuela, Arguedas, Gallegos, Mallea, Asturias and Fuentes will be analyzed. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Navascués

582 Cervantes: Theater and Novels *II, 3*
Reading and critical interpretation of selections from *Comedias* and *Entremeses, Las novelas ejemplares, La Galatea, Persiles y Sigismunda. (Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Hutton

583 The Spanish Baroque *I, 3*
Analysis of *Culteranismo* and *Conceptismo* in Gongora, Quevedo and Gracián. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1975-76.* Kossoff

584 Spanish Problematic Literature *II, 3*
Development of Spanish thought particularly with respect to sociological and cultural problems from the eighteenth century to the contemporary period as seen through the writings of significant essayists. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1975-76.* Hutton

591 Introduction to Research and Criticism *I, 3*
Introduction to scholarly research and literary criticism. Required as the first course for all candidates for the M.A. in Spanish. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Kossoff

592 Religious Sources of Hispanic Literature *II, 3*
Significance of religion in Iberian culture and its reflection in major literary works. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1975-76.* Hutton

594 Seminar in Spanish Literature *I and II, 3*
Research and analysis of a particular author or problem of Spanish or Hispanic-American literature. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

SPEECH (SPE)

400 Rhetoric *I, 3*

410 Semantics *II 3*

415 The Ethics of Persuasion *II, 3*

417 Speech in the Elementary School *I and II, 3*

420 Seminar in American Public Address and Criticism *II, 3*

430 Political Communication *I, 3*

431 Readers Theatre *II, 3*

433 Chamber Theatre *I, 3*

471 Internship in Speech Communication *I or II, 3*

491, 492 Special Problems *I and II, 1-3 each*

504 Speech and Hearing Research *I, 3*
Types of research in speech pathology, audiology, and communication science; critiques of representative models with special emphasis on experimental research; individual pilot projects or master's thesis. *(Lec. 3) Prerequisite: admission to graduate programs in speech, or permission of instructor.* Grubman

551 Measurement of Hearing *I, 2*
History of hearing evaluation techniques; methods and practicum in basic audiological assessment; types of hearing losses and their implications for rehabilitation. *(Lec. 2)* Jirsa or Arnst

552 Advanced Measurement of Hearing *II, 2*
Speech audiometry; recruitment phenomena; functional hearing losses; education and rehabilitation problems associated with electronically assisted hearing. *(Lec. 2) Prerequisite: SPE 551 or equivalent.* Jirsa or Arnst

553 Pedoaudiology *I, 2*
Hearing evaluation problems associated with infants and preschool children; instrumentation and procedures; behavioral characteristics of hearing-impaired children. *(Lec. 2)* Arnst

554 Auditory Training and Speechreading *II, 2*
Rationale and techniques for auditory training programs; speechreading as a communication system; evaluation of methodologies for developing speechreading skills; practicum with children and adults. *(Lec. 2) Prerequisite: SPE 551 or permission of instructor.* Arnst

555 Electronically Assisted Hearing *I, 2*
Principles of selective amplification and acoustical control; evaluation of various devices including wearable hearing aids; methods of instruction in the use of acoustical instruments. *(Lec. 2) Prerequisite: SPE 552 or permission of instructor.* Jirsa or Arnst

556 Automatic Audiometry *II, 2*
Bekesy principle; continuous, discrete, and pulsetone measurements; diagnostic implications of various type tracings; research findings and current issues; practicum. *Lec. 2) Prerequisite: SPE 552 or permission of instructor.* Regan

561 Disorders of Articulation *I, 2*
Types and causes of articulation disorders; rationale for case selection; S-R-L syndrome; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2)* Grubman

562 Disorder of Voice *I, 2*
Type and cause of voice disorders; rationale for case selection; medical implications; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2)* Beaupre

563 Disorders of Rate and Rhythm *II, 2*
Types and causes of rate, rhythm and stress disorders; rationale for case selection; survey of stuttering theories, special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2)* Fitz-Simons

564 Disorders of Symbolization *II, 2*
Types and causes of language symbolization disorders; rationale for case selection; childhood aphasia and autism; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2)* FitzSimons

565 Diagnostic Procedures: Voice and Articulation *I, 2*
Instrumentation, tests, and procedures for evaluating individuals with voice and articulation disorders; practicum in speech and hearing centers; principles of differential diagnosis and report writing. *(Lec. 2) Prerequisite: permission of instructor.* Grubman

566 Diagnostic Procedures: Rhythm and Symbolization *II, 2*
Instrumentation, tests, and procedures for evaluating individuals with disorders of rate, rhythm and symbolization; problems in differential diagnosis; practicum in speech and hearing centers. *(Lec. 2) Prerequisite: permission of instructor.* Grubman

567 Clinical Practicum in Speech Pathology *I and II, 1-3*
Supervised diagnostic and therapeutic procedures with persons experiencing communicative disorders. Differential diagnosis, parent counseling, and cooperation with allied personnel. Practicum held on campus and within institutional and school settings. *(Lab. 3-9) Prerequisite: permission of adviser.* Staff

568 Clinical Practicum in Audiology *I and II, 1-3*
Supervised clinical practicum concerned with audiological assessment of hearing disorders and auditory rehabilitation with the hearing impaired. Practicum held on campus and within institutional and school setting. *(Lab. 3-9) Prerequisite: permission of adviser.* Staff

571 Audiometric Screening and Surveying Techniques *I, 3*
Rationale, instrumentation, and techniques for selecting and administering group and individual screening tests; records and interpretations; current research and professional issues. *(Lec. 3) Prerequisite: admission to graduate program in audiology.* Jirsa or Arnst

572 Medical Audiology *II, 3*
Diagnostic implications of audiometry for various organic disorders; supportive audiological information relevant to medical and surgical interventions; differential data associated with otosclerosis, Meniere's disease, VIIIth cranial nerve tumors, and malingering. *(Lec. 3) Prerequisite: admission to graduate program in audiology.* Jirsa or Arnst

573 Contemporary Problems in Audiology *I, 3*
Critical reveiw of current research and controversial issues within the profession; student selects one topic for independent study. *(Lec. 3) Prerequisite: admission to graduate program in audiology and permission of instructor.* Jirsa or Arnst

574 Environmental Audiology *II, 3*
Hearing problems in industry, in the military, and other high noise level environments; medico-legal aspects of hearing loss; hearing conservation programs in public schools. *(Lec. 3) Prerequisite: admission to graduate program in audiology or permission of instructor.* Jirsa

575 Speech and Language for Deaf or Hard of Hearing Child *I, 3*
The audiologist as hearing therapist in public school settings, medical clinics, and pre-school programs; responsibilities as part of the educational, psychological and medical team for active intervention with speech and language problems. *(Lec. 3) Prerequisite: admission to the graduate program in audiology or permission of instructor.* Arnst

576 Speech and Language for Deaf or Hard of Hearing Adult *II, 3*
The audiologist as hearing therapist and consultant for adults with agenerative or degenerative hearing deficits; responsibilities as part of the rehabilitation team for active intervention with speech and language problems. *(Lec. 3) Prerequisite: admission to graduate program in audiology or permission of instructor.* Arnst

581 Cerebral Palsy *I, 3*
Identification of types of cerebral palsy by location of lesion, motor symptomatology and additional handicaps; role of the speech clinician on the team; types of speech therapy with emphasis on the Bobath approach; current research and controversial issues. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* Staff

582 Stuttering and Cluttering *II, 3*
Analysis of the various etiological theories of stuttering and tachyphemia; techniques and implications of the several therapies; developing a rationale for intervention and case selection. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* FitzSimons

583 Cleft Palate and Other Orafacial Deformities *I, 3*
Relationship of prosthetic, surgical, and orthodontic intervention to speech rehabilitation; role of speech clinician on the cleft palate team; assessment of therapeutic approaches; current research and controversial issues. *(Lec. 3) Prerequisite: admission to the graduate program in speech pathology or permission of instructor.* Grubman

584 Delayed Speech and Language *II, 3*
Problems in differential diagnosis for deafness, aphasia, autism, and learning disorders; demonstrations and critiques of clinical interventions with children who have speech and language learning deficits including dyslexia and acalculia. *(Lec. 3) Prerequisite: admission to the graduate program in speech pathology.* FitzSimons

585 Aphasia and Allied Language Disorders *I, 3*
Types of adult aphasia; central and peripheral dysarthrias; role of speech clinician on the rehabilitation team; other degenerative disorders such as Parkinsonism and dystonia; current research and controversial issues. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology or permission of instructor.* Grubman or Beaupre

586 Alaryngeal Speech *II, 3*
Voice and speech rehabilitation for individual without a functional larynx; social, emotional and medical considerations; clinical procedures for esophageal, pharyngeal and buccal speech; implications for use of artificial larynx; current research. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* Beaupre

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

STATISTICS

Experimental Statistics

408 or 409 Statistical Methods in Research I
412 Statistical Methods in Research II
413 Data Analysis
491, 492 Problems in Experimental Statistics
500 Nonparametric Statistical Methods
511 Linear Statistical Models
520 Fundamentals of Sampling and Applications
532 Experimental Design
541 Multivariate Statistical Methods
550 Ecological Statistics
591, 592 Problems in Experimental Statistics

Industrial Engineering

411 Engineering Statistics I
412 Engineering Statistics II
513 Statistical Quality Control
533 Advanced Statistical Methods for Research and Industry
634 Design and Analysis of Industrial Experiments
635 Response Surfaces and Evolutionary Operations

Management Science

581 Fundamental Business Statistics
601, 602 Advanced Business Statistics

Mathematics

451 Introduction to Probability and Statistics
452 Mathematics Statistics
456 Probability
550 Advanced Probability
551 Advanced Mathematical Statistics I
552 Advanced Mathematical Statistics II

Mechanical Engineering and Applied Mechanics

521 Reliability Analysis and Prediction

Psychology

410 Quantitative Methods in Psychology II
510 Intermediate Quantitative Methods in Psychology
610 Factor Analysis

Resource Economics

576 Econometrics I
577 Econometrics II

TEXTILES AND CLOTHING (TXC)

405 Advanced Clothing *I and II, 3*

406 Housing Planning *I, 3*

422 Field Experience in Fashion Merchandising *I and II, 5*

433 Textiles and Clothing Industry *I and II, 3*

440 Historic Textiles *I, 3*

502 Seminar in Textiles and Clothing *I and II, 3*
Original investigations in the area of clothing problems. *(Lec. 3) Prerequisite: permission of department.* Carpenter

503 Advanced Textiles *I and II, 3*
Analysis of fabrics; methods and techniques of testing fabrics; evaluation of fabric data in relation to end-use performance and to existing quality standards. *(Lec. 2, Lab. 2) Prerequisite: TXC 303.* Helms

524 Seminar in Textiles and Clothing *II, 3*
Literature in the field of textiles and clothing, review of research for textiles and clothing problems. *(Lec. 3)* Carpenter

533 Textile and Clothing Economics *I and II, 3*
Economic development of production and distribution of textiles and clothing. *(Lec. 3)* Staff

540 Special Problems in Textiles and Clothing *I and II, 3*
Supervised independent study in specific areas of textiles and clothing. *Prerequisite: permission of department.* Staff

550 Seminar and Practicum *I and II, 3*
Professional role of the textiles and clothing specialist. *Prerequisite: permission of department.* Staff

560 Special Problems in Textiles and Clothing *I and II, 3*
Supervised independent study in specific areas of textiles and clothing. *Prerequisite: permission of department.* Staff

570 Seminar in Textiles and Clothing Research *I and II, 3*
Critical study of research literature and research techniques. *Prerequisite: permission of department.* Staff

580 Research Methods in Textiles and Clothing *I and II, 3*
Development and execution of research in textiles and clothing following the historical, descriptive, and experimental methods. Analysis of current research in the field. *(Lec. 2, Lab. 2)* Carpenter

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

THEATRE (THE)

405 Children's Theatre Laboratory *I and II, 2*

410 Advanced Acting *I and II, 1-3*

420 Advanced Directing Practice *I and II, 1-3*

440 Advanced Stage Management *I and II, 1-3*

450 Advanced Costuming *I and II, 1-3*

460 Advanced Scene Design *I and II, 1-3*

461 Advanced Theatre Technology *I and II, 1-3*

470 Advanced Stage Lighting *I and II, 1-3*

482 Contemporary Theatre *I, 3*

ZOOLOGY (ZOO)

408 Introduction to Protozoology *II, 4*

421 Principles of Taxonomy *I, 3*

427 Modeling and Analysis of Dynamic Systems *I, 3*

441 General (Cellular) Physiology *I, 3*

442 Mammalian Physiology *II, 3*

455 (or BOT 455) Marine Ecology *I, 3*

457 (or BOT 457) Marine Ecology Laboratory *I, 1*

463 Animal Ecology *II, 3*

465 Limnology *I, 3*

466 Vertebrate Biology *II, 3*

467 Animal Behavior *II, 3*

468 Mammalogy *II, 3*

475 Causes of Evolution *I, 3*

476 (477) Human Genetics *II, 3*

482 Systematic Entomology *II, 3*

484 (or ELE 484) Modeling of Physiological Systems *II, 3*

505 Biological Photography *I, 2*
Application of scientific photography to biological subjects, living and prepared. Photomacrography and photomicrography. Principles of photography as applied to the specialized needs of biological research and publication. *(Lab. 6) Prerequisite: permission of instructor.* Heppner

508 Seminar in Zoological Literature *II, 1*
Survey of zoological literature including traditional methods of bibliographic control, contemporary information retrieval services and the development of a personalized information system. *(Lec. 1) Prerequisite: graduate standing in zoology.* C. Winn

512 Fine Structure *II, 4*
Experimental evidence correlating the fine structure and function of cell organelles, including especially the plasma membrane, endoplasmic reticulum, mitochondria, ribosomes, centrioles, lysosomes and cilia. Introduction to instrumental and to cytochemical methods for study of each cell. Emphasis on the examination of electron micrographs. *(Lec. 3, Lab. 3) Prerequisite: ZOO 315. In alternate years, next offered 1974-75.* Goertemiller

518 Mechanisms of Development *II, 2*
Current concepts of mechanisms responsible for developmental changes. Morphological, chemical, and genetic aspects of development are treated in discussions of morphogenetic movements, cell differentiation, and organogenesis. *(Lec. 2) Prerequisite: ZOO 314 or equivalent; BOT 352 recommended.* Bibb, Goertemiller, Surver

531 Advanced Parasitology Seminar *I, 2*
Advanced topics in the host-parasite relationships of protozoan and metazoan parasites. Reading knowledge of one foreign language assumed. Topics vary from year to year. *(Lec. 2) Prerequisite: ZOO 331 or equivalent. In alternate years, next offered 1974-75.* Hyland

541, 542 Comparative Physiology *I and II, 3 each*
Comparison of physiological mechanisms by which animals maintain life, emphasis on marine invertebrates. *(Lec. 2, Lab. 3) Prerequisite: ZOO 345 and 354. ZOO 541 is not prerequisite for ZOO 542. ZOO 541:* Responses to external environment mediated by receptors, nervous systems, effectors. Living control systems for muscular activity and circulation. Hill *ZOO 542:* Processes related to maintenance of internal environment, including osmotic balance, gaseous exchange and transport, nutrition, intermediary metabolism, nitrogen excretion, shell formation. Hammen

543 Biology of Reproduction in Animals *I, 3*
Aspects of reproduction in animals of different phyla. Hormonal interrelationships, environmental control and adaptive mechanisms. *(Lec. 2, Lab. 3) Prerequisite: ZOO 345 and 545. In alternate years, next offered 1974-75.* Chipman

545 Endocrinology *I, 3*
Comparative anatomy, histology, embryology, physiology of the endocrine glands of vertebrates. Lectures, demonstrations, student reports. *(Lec. 3) Prerequisite: ZOO 314 and 315 or equivalent.* Staff

548 Neurophysiology *II, 4*
Fundamental processes occurring in the nervous systems of invertebrates and vertebrates. Structure and functions of nervous elements with emphasis on integration and coordination. *(Lec. 3, Lab. 3) Prerequisite: ZOO 345, MTH 141 or equivalent recommended and permission of instructor. In alternate years.* Kass-Simon

554 Seminar in Morphogenetic Theory *II, 2*
Recent investigations in developmental physiology, and the control of differentiation and development. Reference to original papers. *(Lec. 2) Prerequisite: ZOO 315 or equivalent, and permission of instructor. In alternate years, next offered 1975-76.* Goertemiller

562 Seminar in Behavioral Ecology *I, 1*
Special topics in the relationships between animal behavior and ecology, such as social organization of animals, evolution of behavior, competition and habitat selection. Discussion and presentation of individual reports. *(Lec. 1)* Cobb

563 Ichthyology *I, 3*
Fishes of the world. Their structure, evolution, classification, ecology and physiology. Emphasis on local marine and freshwater fauna. Several field trips. *(Lec. 2, Lab. 3) Prerequisite: ZOO 314 and 466.* Krueger

564 Oceanic Ichthyology *II, 3*
Fishes of the great ocean basins. Their systematics, adaptations, vertical distribution and zoogeography. Emphasis on mesopelagic and bathypelagic forms in the North Atlantic. *(Lec. 2, Lab. 3) Prerequisite: ZOO 563 or permission of instructor. In alternate years, next offered 1974-75.* Krueger

566 Herpetology *II, 3*
Biology of recent orders of amphibians and reptiles; emphasis on adaptations and evolution, world faunal relationships past and present, current systematic problems. Selected herpetological material in laboratory, field trips, two week-end trips to the American Museum of Natural History. *(Lec. 2, Lab. 3) Prerequisite: ZOO 314 or permission of instructor.* Dowling and Shoop

568 Ornithology *II, 2*
Biology of birds, with emphasis on the role of birds in biological research. Areas covered include systematics, evolution, physiology, ecology and behavior. Discussion of current topics in ornithology. *(Lec. 2) Prerequisite: ZOO 466 or permission of instructor.* Heppner

573 Developmental Genetics *I, 3*
Genetic control of gametogenesis and fertilization. Survey of modern approaches to the problem of gene regulation during embryogenesis with animal systems. *(Lec. 3) Prerequisite: ASC 352 or equivalent and permission of instructor. In alternate years.* Surver

576 Ecological Genetics *II, 4*
Hereditary structure of populations, population strategy in heterogeneous environment, species area-diversity patterns, strategy of colonization, stepping stones and biotic exchange. *(Lec. 3, Lab. 3) Prerequisite: one semester of genetics.* Costantino

579 (or BOT 579) Advanced Genetics Seminar *I and II, 1*
Current topics in genetics, including cytological, ecological, molecular, physiological, population, quantitative and radiation genetics. *(Lec. 1) Prerequisite: BOT 352 or ASC 352 and permission of instructor.* Costantino and Mottinger

581 General Acarology *I, 3*
Detailed study of mites and ticks, their structure, life histories, and classification. Free-living forms as well as plant and animal feeders. *(Lab. 6) Prerequisite: ZOO 331 or 481 or 586, and permission of instructor. In alternate years, next offered 1974-75.* Hyland

586 Medical and Veterinary Entomology *II, 3*
Life histories, classifications, habits and control of insects and other arthopods which affect the health of man and animals. Duties of the entomologist on public health team, including field practice in methods of insect surveys, control measures and subsequent surveys to determine success of control measures. *(Lec. 1, Lab. 4) Prerequisite: ZOO 331 or 381 or equivalent. In alternate years, next offered 1975-76.* Hyland

595, 596 Graduate Seminar in Zoology *I and II, 1 each*
Consideration of philosophy and techniques of research and information presentation at the graduate level. Reports by students, critique and discussion by class. *Required of entering graduate students in zoology. Prerequisite: graduate standing. S/U credit.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

640 to 645 Seminar in Physiology *I and II, 1-3 each*
Reports and discussions on topics of current research in physiology. Subject matter adapted to meet interests of staff and students. *(Lec. 1-3) Prerequisite: ZOO 345.* Harrison and Hill

646 Advanced Mammalian Physiology *II, 2*
Reports and discussions on topics of current research in mammalian physiology, coordinated with ZOO 442. Assigned research projects using advanced physiological techniques and instrumentation. *(Rec. 1, Lab. 3) Prerequisite: concurrent enrollment in ZOO 442 or permission of instructor.* Hill

648, 649 Seminar in Environmental Physiology *I and II, 2 each*
Reading, library research, special lectures on topics of current research interest in environmental physiology. *(Lec. 2) Prerequisite: one year of physiology, and at least one course in ecology or permission of department.* Staff

664 Seminar in Ichthyology *II, 2*
Reading, library research, reports and class discussion on problems of current research interest in the biology of fishes. *(Lec. 2) Perequisite: ZOO 563 or permission of department.* Krueger

666 Physiological Ecology *II, 3*
Comparative study of physiological adjustments which animals make in response to environmental factors, with emphasis on the physiological basis of animal distribution and evolution. *(Lec. 3) Prerequisite: one year of physiology and a course in ecology.* Staff

668 Laboratory in Physiological Ecology *II, 3*
Application of laboratory techniques to research problems in physiological ecology, such as energetics, gas exchange, thermoregulation and temperature tolerance, salt and water balance, and acclimatization to various environmental factors. Assigned research project on advanced level. *(Lab. 9) Prerequisite: ZOO 666 (may be taken concurrently with ZOO 666) and permission of department.* Staff

670 to 675 Advanced Ecology Seminars *I and II, 2 each*
Specialized and advanced areas of ecological research and theory, including zoogeography, pleistocene ecology, population dynamics, energy flow in ecosystems and radiation ecology. *Prerequisite: ZOO 463 and permission of department.* Shoop and Staff

679 Animal Communication
See Oceanography 679.

681 Biological Clocks and Orientation
See Oceanography 681.

691, 692 Assigned Work *I and II, 1-3 each*
Subject matter adapted to meet needs of student. May be arranged with any member of the staff, with the permission of the head of the department. *(Lec. 3 or Lab. 6)* Staff

693, 694 Zoological Problems *I and II, 1-3 each*
Special work to meet needs of individual students who are prepared to undertake special problems. *(Lec. 3 or Lab. 6)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

y = mx + b
Solb
S = 7.5 + 0.2E
X
B2

Personnel

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VINCENT C. ROSE, *Associate Dean*

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ELIJAH SWIFT, *Oceanography* (1976)
One faculty member to be appointed by the Dean.
One student member to be appointed by the Dean.

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GRADUATE FACULTY

First date after title indicates appointment to present position; the second date, when the first fails to do so, indicates first appointment in the University.

PAUL IRVING ABELL, *Professor of Chemistry, 1964, 1951.* B.S., 1948, University of New Hampshire; Ph.D., 1951, University of Wisconsin.

ELIE ABUSHANAB, *Associate Professor of Medicinal Chemistry, 1973, 1970.* B.S., 1960, American University of Beirut; M.S., 1962; Ph.D., 1965, University of Wisconsin.

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LUKE S. ALBERT, *Professor of Botany, 1970, 1960.* B.S., 1950, Lebanon Valley College; M.S., 1952; Ph.D., 1958, Rutgers—The State University.

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ANTHONY J. ALLEN, *Assistant Professor of Education, 1969.* B.S., 1960, Loyola University; M.Ed., 1967; Ph.D., 1970, Boston College.

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AARON JOHN ALTON, *Professor of Marketing Management, 1961.* A.B., 1942, Miami University (Ohio); M.B.A., 1947, Harvard Business School; Ph.D., 1956, Ohio State University.

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STANLEY M. BARNETT, *Assistant Professor of Chemical Engineering, 1969.* B.A., 1957, Columbia College; B.S., 1958, Columbia University; M.S., 1959, Lehigh University; Ph.D., 1963, University of Pennsylvania.

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LEONARD J. BASS, *Assistant Professor of Computer Science, 1970.* B.A., 1964; M.A., 1966, University of California, Riverside; Ph.D., 1970, Purdue University.

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AMAR CHOUDRY, *Associate Professor of Physics, 1974, 1967* (Leave Sem. I, II). B.Sc., 1956; M.Sc. 1958, Delhi University; Ph.D., 1967, Columbia University.

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DAVID H. CROMBE, *Assistant Dean of the College of Pharmacy and Associate Professor of Pharmacy Administration, 1966.* Ph.G., 1933; B.S., 1934, Rhode Island College of Pharmacy; M.S., 1935, University of Southern California.

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RUTH G. CUMINGS, R.N., *Professor of Community Mental Health Nursing, 1970.* R.N., 1935, Jewish Hospital Training School for Nurses; B.S., 1944, New York University (Washington Square College); M.A., 1950; Ed.D., 1964, Teachers College, Columbia University.

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BENJAMIN KAZAN, *Adjunct Professor of Electrical Engineering, 1969.* B.S., 1938, California Institute of Technology; M.A., 1940, Columbia University; Ph.D., 1961, Technische Hochschule, Germany.

DALE CURTISS KRAUSE, *Adjunct Professor of Oceanography, 1973, 1962.* B.S., 1952, California Institute of Technology; M.S., 1957; Ph.D., 1961, University of California.

OSCAR CHUM LIU, *Adjunct Professor of Animal Pathology, 1965.* M.D., 1943, Cheeloo University; D.M.Sc., 1952, University of Pennsylvania.

EDWARD J. MODEST, *Adjunct Professor of Medicinal Chemistry, 1971, 1968.* A.B., 1943, Harvard College; A.M., 1947; Ph.D., 1949, Harvard University.

MARK B. MOFFETT, *Adjunct Associate Professor of Ocean Engineering, 1974, 1970.* B.S., M.S., 1959, Massachusetts Institute of Technology; Ph.D., 1970, Brown University.

MARIO A. NICOTRA, *Adjunct Clinical Professor of Psychology, 1967.* Diplomate, 1935, Licee; M.D., 1941, University of Rome.

DONALD K. PHELPS, *Adjunct Assistant Professor of Oceanography, 1969.* B.A., 1951; M.S., 1958; Ph.D., 1964, University of Rhode Island

SRECKO J. POGACAR, *Adjunct Assistant Professor of Pharmacology, 1969.* M.D., 1953, University of Ljubljana.

JAN C. PRAGER, *Adjunct Associate Professor of Microbiology, 1967.* B.Sc., 1954; M.Sc., 1956, University of Cincinnati; Ph.D., 1961, New York University.

CHARLES S. SAHAGIAN, *Adjunct Assistant Professor of Chemical Engineering, 1970.* B.S., 1950, Boston College.

KARL E. SCHAEFER, *Adjunct Professor of Zoology, 1965.* M.D., 1936, University of Kiel.

DAVID M. SHAW, *Adjunct Professor of Oceanography, 1969.* B.S., 1956, Queens College; M.A., 1966; Ph.D., 1969, Columbia University.

EMORY G. SIMMONS, *Adjunct Professor of Botany, 1972.* A.B., 1941, Wabash College; A.M., 1946, DePauw University; Ph.D., 1950, University of Michigan.

MOLLIE STEVENS SMART, *Adjunct Professor of Child Development and Family Relations, 1973, 1954* (Leave Sem. I, II). B.A., 1936, University of Toronto; M.A., 1940, University of Michigan; Ph.D., 1970, University of Delhi.

LEO A. SPANO, *Adjunct Assistant Professor of Chemical Engineering, 1967.* B.S., 1943, M.S., 1948, University of Rhode Island.

WILTON STURGES III, *Adjunct Professor of Oceanography, 1973, 1966.* B.S., 1957, Alabama Polytechnic Institute; M.A., 1963; Ph.D., 1966, The Johns Hopkins University.

CLARENCE M. TARZWELL, *Adjunct Professor of Plant Pathology-Entomology, 1965.* A.B., 1930; M.S., 1932; Ph.D., 1936, University of Michigan.

CAROL J. THOMAS, *Adjunct Professor of Community Planning and Area Development, 1971.* B.S., 1948, Syracuse University; M.S., 1948, University of Connecticut.

GERALD E. ZAROOGIAN, *Adjunct Associate Professor of Food and Resource Chemistry, 1969.* B.S., 1958, University of Rhode Island; M.S., 1960; Ph.D., 1963, Purdue University.

RALPH ZIRKIND, *Adjunct Professor of Electrical Engineering, 1973.* B.S., 1940, City College of New York; M.S., 1946, Illinois Institute of Technology.

GRADUATE CLINICAL APPOINTMENTS

JOSEPH N. GALLINA, *Clinical Associate Professor of Pharmacy, 1970.* B.S., 1960, Rutgers—The State University; Pharm.D., 1965, University of California.

LOUIS PAUL JEFFREY, *Clinical Professor of Pharmacy, 1969.* B.S., 1953; M.S., 1955, Massachusetts College of Pharmacy.

JOHANNA E. MOHRNHEIM, *Clinical Professor of Psychology, 1970.* Cand. Med. 1944, M.D., 1949, University of Hamburg.

THEODORE F. PINKUS, *Clinical Assistant Professor of Pharmacy, 1972.* B.S., 1965, Massachusetts College of Pharmacy; Pharm.D., 1972, University of Cincinnati.

WILLIAM C. REDMON, *Clinical Professor of Psychology, 1969.* B.S., 1937, University of Kentucky; M.D., 1942, University of Cincinnati Medical School.

ROGER A. RICHARDSON, *Clinical Assistant Professor of Psychology, 1967.* B.A., 1960, Colby College; M.A., 1963, University of Maine; Ph.D., 1967, Louisiana State University.

Graduate School Calendar

PLEASE NOTE: Requests for scheduling examinations must be submitted to the Graduate School office at least ten days prior to the date(s) requested. Oral and written examinations, including qualifying and comprehensive examinations and defenses of theses, will not be scheduled during periods when the University is in recess. During the winter intersession and the summer session, such examinations will be scheduled only at the convenience of the faculty members involved, and depend upon the availability of the candidate's program committee and additional qualified examiners. Students wishing to take any such examinations during these times should check first about availability and convenience of faculty members. If they are not registered for course work or research during the summer session, students should register for Continuous Registration.

FALL SEMESTER 1974

August 7, Wednesday
Final date for continuing students to pay fall semester bills without penalty.

September 3, Tuesday
Graduate registration, 8:00 a.m. to 7:15 p.m., Tootell Gynasium. Fees for new students must be paid at time of registration. There is a late fee for continuing students who did not register in April or who did not pay fall semester bills in August.

September 4, Wednesday
Classes begin, 8:00 a.m.

September 20, Friday
Final date for dropping courses without $5 penalty fee.
Final date for January master's degree candidates to submit thesis proposals.

September 23, Monday
Final date for adding courses or for changing from audit to credit.

October 14, Monday
Holiday, Columbus Day

October 25, Friday
Final date for June doctoral degree candidates to submit thesis proposals.
Mid-semester.
Final date for dropping courses without grading.

October 28, Monday
Holiday, Veterans Day

November 11 to 15
Graduate registration for 1975 spring semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

November 27, Wednesday
Thanksgiving recess begins, 5:00 p.m.

December 2, Monday
Thanksgiving recess ends, 8:00 a.m.

December 13, Friday
Classes end.

December 16 to 21
Final examinations.

December 20, Friday
Final date for students admitted in September 1974 to submit programs of study.

December 23, Monday
Due date in Princeton, N.J., for registration forms for February 1 ETS language examinations.

December 24, Tuesday
Last day for grades, 12:00 noon.

January 2, Thursday
Final date for January candidates to submit completed master's and doctoral theses in a form acceptable

for examination purposes along with the request for oral defense of the thesis. *No extension of time will be granted.* Theses must be submitted at least ten days prior to the date requested for the oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below and note at beginning of this calendar regarding scheduling examinations during the winter intersession.

SPRING SEMESTER 1975

January 20, Monday
Graduate registration, 8:00 a.m. to 7:15 p.m., Tootell Gynasium. Fees for new students must be paid at the time of registration. There is a late fee for continuing students who did not register in November or who did not pay semester bills in December.

January 21, Tuesday
Classes begin, 8:00 a.m.
Final date for January degree candidates to submit master's and doctoral theses, which have been successfully defended, in final form, 4:00 p.m.

January 24, Friday
Final date for June master's degree candidates to submit thesis proposals.

February 1, Saturday
ETS language examinations in French, German, Russian and Spanish.

February 5, Wednesday
Final date for dropping courses without $5 penalty fee.

February 7, Friday
Final date for adding courses or for changing from audit to credit.

March 3, Monday
Due date in Princeton, N.J., for registration forms for April 12 ETS language examinations.

March 14, Friday
Mid-semester.
Final date for August doctoral degree candidates to submit thesis proposals.

March 21, Friday
Final date for dropping courses without grading.
Spring recess begins, 5:00 p.m.

March 31, Monday
Spring recess ends, 8:00 a.m.

April 7 to 11
Graduate registration for 1975 fall semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

April 12, Saturday
ETS language examinations in French, German, Russian and Spanish.

April 28, Monday
Final date for June degree candidates to submit completed master's and doctoral theses in a form acceptable for examination purposes, along with the request for oral defense of thesis. *No extension of time will be granted.* Theses must be submitted at least ten days prior to the date requested for the oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below.

May 9, Friday
Last day of classes.

May 12 to 17
Final examinations.

May 16, Friday
Final date for students admitted in January 1975 to submit programs of study.

May 19, Monday
Due date in Princeton, N.J. for registration forms for June 28 ETS language examinations.

May 20, Tuesday
Last day for grades, 4:00 p.m.

May 27, Tuesday
Final date for all June degree candidates to submit master's and doctoral theses, which have been successfully defended, in final form, 4:00 p.m.

May 28, Wednesday
Final date for August master's and January's doctoral degree candidates to submit thesis proposals.

June 1, Sunday
Commencement.

SUMMER SESSION 1975

NOTE: All courses taken by graduate students during summer sessions are subject to the same regulations, regarding inclusion in programs of study and calculation of overall academic average, etc., as are courses taken during the regular academic year. Students wishing to take directed studies or special problems courses during summer sessions must obtain individual approval for these courses from the Dean of the Summer Session unless the specific offering is listed in the *Summer Session Bulletin* for that year. Students wishing to enroll for thesis or dissertation research during summer sessions must ascertain first that their major professors and/or members of their thesis or dissertation committees will be available and are willing to provide the necessary supervision. See also the important note at the beginning of this calendar regarding scheduling of examinations, including defenses of theses, during summer sessions.

See *Summer Session Bulletin* available at Summer Session Office.

June 28, Saturday
ETS language examinations in French, German, Russian and Spanish.

July 4, Friday
Holiday, Independence Day

August 4, Monday
Final date for all August degree candidates to submit completed master's and doctoral theses in a form acceptable for examination purposes, along with the request for oral defense of the thesis. *No extension of time will be granted.* Theses must be submitted at least ten day prior to the date requested for the oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below.

August 11, Monday
Holiday, Victory Day

August 25, Monday
Final date for all August degree candidates to submit master's and doctoral theses, which have been successfully defended, in final form, 4:00 p.m.

1974

SEPTEMBER

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1975

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Academic and Service Buildings and Areas

1 Administration Building C3
2 Administrative Services Center
campus mail A1
4 Athletic Bubble D1
5 Ballentine Hall
business administration B3
6 Beck Field D1
7 Biological Sciences Building A3
8 Bliss Hall *engineering* B4
9 Career Planning and Placement
(70 Lower College Rd.) C3
10 Catholic Center B4
11 Chafee Social Science Center A3
12 Child Development Center E3
13 Community Planning
(36 Upper College Rd.) D4
14 Community Planning *studios* A4
15 Crawford Hall *chemical engineering* B4
16 Dairy Barn B2
17 Davis Hall C3
18 East Hall *physics* B4
19 Edwards Hall C4
20 Episcopal Center E3
21 Experimental Turf Plots B1
22 Faculty Center B4
23 Fine Arts Center B4
24 Fire Station B5
25 Fogarty Health Science Building
nursing and pharmacy D3
26 Gilbreth Hall *industrial engineering* B4
27 Green Hall D4
28 Greenhouses A4
29 Home Management House E3
30 Horticulture Gardens A4
31 Independence Hall D4
32 Information and Police D3, D4
33 International House B1
34 Keaney Gymnasium D1
35 Kelley Hall *electrical engineering* B4
36 Library B3
37 Library School *graduate*
(74 Lower College Rd.) C3
38 Lippitt Hall B3
39 Meade Field B2
40 Memorial Union D3
41 Morrill Science Building *life sciences* D3
42 Oceanography (19 Upper College Rd.) E4
43 Pastore Chemical Laboratory D3
43A Pastore Annex D3
44 Personnel and Purchasing
(80 Lower College Rd.) C3
45 Planetarium B4
Police and Information (#32) D3, D4
46 Potter Building *infirmary* C2
47 Lower College Road No. 34 D3
48 Upper College Road No. 31 D4
49 Quinn Hall *home economics* C3
50 Ranger Hall *biological sciences* C4
51 Lower College Road No. 37 D3
52 Rifle Range B1
53 Rodman Hall B3
54 Roosevelt Hall C3
55 Sherman Building *maintenance* B1
56 Taft Hall B3
57 Tennis Courts A3, E1
58 Tootell Physical Education Center C1
59 Tyler Hall *computer laboratory* A3
60 Upper College Road No. 85 C4
61 Upper College Road No. 95 C4
62 Wales Hall *mechanical engineering* B4
63 Washburn Hall C4
64 Water Towers A5, B4
65 Watson House B3
66 Woodward Hall *resource development* B3
67 Housing Warehouse B1

Residence and Dining Halls

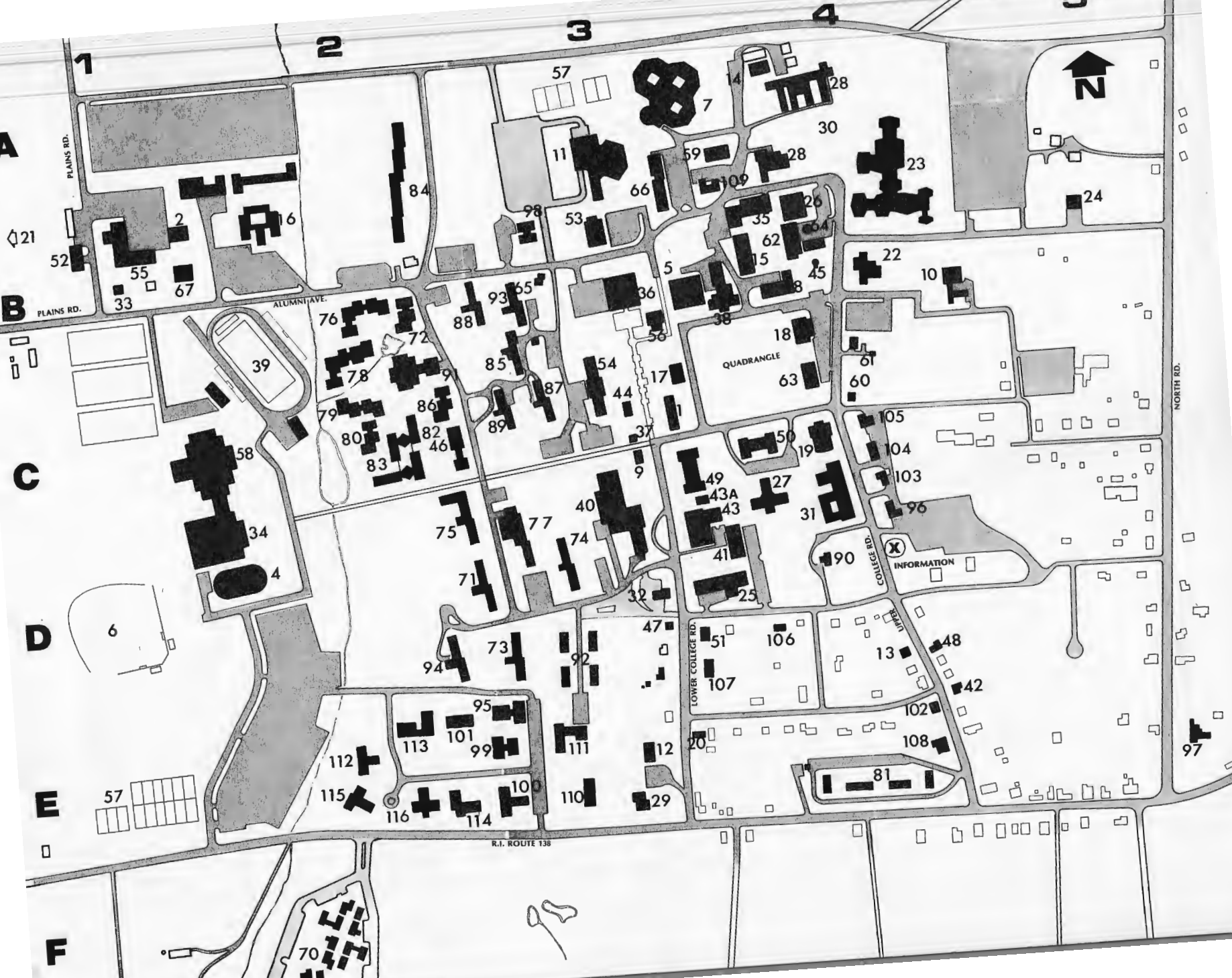
70 Graduate Housing F2
71 Adams Hall D2
72 Aldrich Hall B2
73 Barlow Hall D2
74 Bressler Hall D3
75 Browning Hall D2
76 Burnside Hall B2
77 Butterfield Hall *residence and dining* D3
78 Coddington Hall B2
79 Dorr Hall C2
80 Ellery Hall C2
81 Faculty Apartments E4
82 Fayerweather Hall C2
83 Gorham Hall C2
84 Heathman Hall A2
85 Hope Hall *dining* B3
86 Hopkins Hall C2
87 Hutchinson Hall C3
88 Merrow Hall B2
89 Peck Hall C3
90 President's House D4
91 Roger Williams Commons
housing office and dining C2
92 Student Apartments D3
93 Tucker Hall B3
94 Weldin Hall D2

Fraternities

95 Alpha Epsilon Pi E2
96 Chi Phi D4
97 Lambda Chi Alpha E5
98 Phi Gamma Delta B3
99 Phi Kappa Psi E2
100 Phi Mu Delta E2
101 Phi Sigma Delta E2
102 Phi Sigma Kappa E4
103 Sigma Alpha Epsilon D4
104 Sigma Chi C4
105 Sigma Nu C4
106 Tau Epsilon Phi D4
107 Tau Kappa Epsilon D3
108 Theta Chi E4
109 Thea Delta Chi B3

Sororities

110 Alpha Chi Omega E3
111 Alpha Delta Pi E3
112 Alpha Xi Delta E2
113 Chi Omega E2
114 Delta Zeta E2
115 Sigma Delta Tau E2
116 Sigma Kappa E2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